EXHIBIT A

US007457250B2

(12) **United States Patent**
Austermann, III et al.

(10) **Patent No.: US 7,457,250 B2**
(45) **Date of Patent: *Nov. 25, 2008**

(54) **SYSTEM FOR COMMUNICATING WITH ELECTRONIC EQUIPMENT**

(75) Inventors: **John F Austermann, III**, Huntington Woods, MI (US); **Marshall B Cummings**, Troy, MI (US)

(73) Assignee: **ChriMar Systems, Inc.**, Farmington Hills, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 895 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **10/668,708**

(22) Filed: **Sep. 23, 2003**

(65) **Prior Publication Data**

US 2004/0062203 A1 Apr. 1, 2004

Related U.S. Application Data

(63) Continuation of application No. 09/370,430, filed on Aug. 9, 1999, now Pat. No. 6,650,622, which is a continuation-in-part of application No. PCT/US99/07846, filed on Apr. 8, 1999.

(60) Provisional application No. 60/081,279, filed on Apr. 10, 1998.

(51) **Int. Cl.**
H04L 12/12 (2006.01)
G08B 13/14 (2006.01)

(52) **U.S. Cl.** **370/241**; 370/445; 340/568.1

(58) **Field of Classification Search** ..... None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,359,379 A 12/1967 Pullum et al.

(Continued)

FOREIGN PATENT DOCUMENTS

DE 42 03 304 A1 8/1992

(Continued)

OTHER PUBLICATIONS

"Attachment Module Guide for the IBM Token-Ring Network", IBM, Apr. 1992.

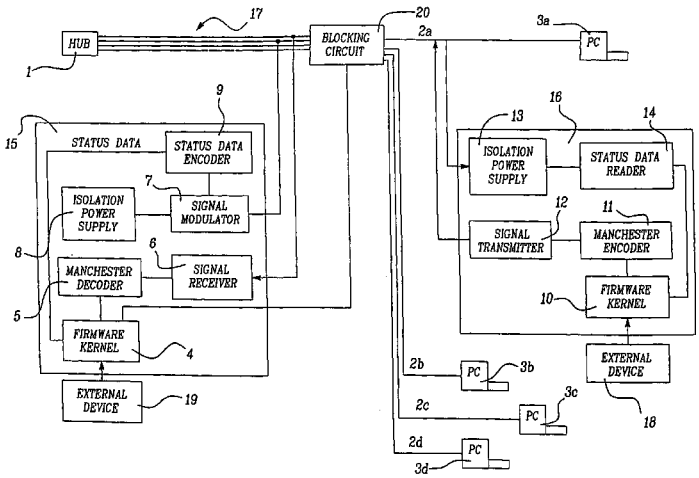
(Continued)

Primary Examiner—Chi H. Pham
Assistant Examiner—Soon D. Hyun
(74) *Attorney, Agent, or Firm*—Harness, Dickey & Pierce, P.L.C.

(57) **ABSTRACT**

In accordance with the teachings of the present invention, a communication system (**17**) is provided for generating and monitoring data over pre-existing conductors (**2**A-**2**D) between associated pieces of networked computer equipment (**3**A-**3**D). The system includes a communication device (**16**) attached to the electronic equipment that transmits information to a central module (**15**) by impressing a low frequency signal on the pre-existing data lines of the remotely located equipment. A receiver (**6**) in the central module (**15**) monitors the low frequency data on the data lines to determine the transmitted information of the electronic equipment. The communication device may also be powered by a low current power signal from the central module (**15**). The power signal to the communication device may also be fluctuated to provide useful information, such as status information, to the communication device. Relocation of the electronic equipment with attached communication device to another location on the network is detected immediately and may be used to update a database. This invention is particularly adapted to be used with an existing Ethernet communications link or equivalents thereof.

126 Claims, 13 Drawing Sheets



U.S. PATENT DOCUMENTS

3,407,400	A	10/1968	Lurie	340/517
3,408,643	A	10/1968	Sliman	340/568.1
3,425,050	A	1/1969	Tellerman et al.	340/571
3,537,095	A	10/1970	Cones	340/517
3,659,277	A	4/1972	Brown	340/870.2
3,696,378	A	10/1972	Daniel	340/568.2
3,697,984	A	10/1972	Atkinson et al.	340/505
3,794,989	A	2/1974	Manley et al.	340/517
3,836,901	A	9/1974	Matto et al.	340/522
3,863,036	A	1/1975	McCrudden	
3,932,857	A	1/1976	Way et al.	340/568.2
4,024,359	A	5/1977	De Marco et al.	379/22.02
4,024,360	A	5/1977	Biraghi et al.	370/200
4,063,220	A	12/1977	Metcalfe et al.	370/462
4,121,201	A	10/1978	Weathers	
4,156,799	A	5/1979	Cave	
4,173,714	A	11/1979	Bloch et al.	370/200
4,230,912	A	10/1980	Lee et al.	
4,273,955	A	6/1981	Armstrong	178/69 G
4,293,948	A	10/1981	Soderblom	370/424
4,340,788	A	7/1982	Sbuelz	370/250
4,348,661	A	9/1982	Lucchesi	340/510
4,383,315	A	5/1983	Torng	370/452
4,454,477	A	6/1984	Joffe	379/380
4,464,658	A	8/1984	Thelen	370/228
4,479,228	A	10/1984	Crane	375/219
4,482,999	A	11/1984	Janson et al.	370/452
4,495,494	A	1/1985	McCune	
4,524,349	A	6/1985	Hyatt	340/500
4,551,671	A	11/1985	Annunziata et al.	324/539
4,578,539	A	3/1986	Townsing	379/106.11
4,602,364	A	7/1986	Herman et al.	370/462
4,617,656	A	10/1986	Kobayashi et al.	370/445
4,622,541	A	11/1986	Stockdale	340/566
4,631,367	A	12/1986	Coviello et al.	
4,633,217	A	12/1986	Akano	340/310.15
4,636,771	A	1/1987	Ochs	
4,647,721	A	3/1987	Busam et al.	379/102.04
4,647,912	A	3/1987	Bates et al.	370/463
4,649,548	A	3/1987	Crane	375/219
4,654,640	A	3/1987	Carll et al.	340/568.2
4,658,242	A	4/1987	Zeder	340/568.4
4,670,902	A	6/1987	Naiwirt	
4,674,084	A	6/1987	Suzuki et al.	370/509
4,685,129	A	8/1987	Gavrilovich	379/324
4,691,344	A	9/1987	Brown et al.	379/106.11
4,701,630	A	10/1987	Annunziata et al.	307/112
4,701,946	A	10/1987	Oliva et al.	379/102.04
4,719,616	A	1/1988	Akano	370/527
4,728,948	A	3/1988	Fields	340/3.71
4,731,829	A	3/1988	Bonnet et al.	
4,733,223	A	3/1988	Gilbert	340/505
4,733,389	A	3/1988	Puvogel	
4,736,195	A	4/1988	McMurtry et al.	
4,737,787	A	4/1988	Ito et al.	340/870.18
4,755,922	A	7/1988	Puvogel	363/21.16
4,758,823	A	7/1988	Berruyer et al.	340/524
4,760,382	A	7/1988	Faulkner	340/568.2
4,766,386	A	8/1988	Oliver et al.	324/533
4,782,322	A	11/1988	Lechner et al.	340/310.02
4,813,066	A	3/1989	Holtz et al.	
4,862,158	A	8/1989	Keller et al.	370/439
4,864,598	A	9/1989	Lynch et al.	379/22.02
4,866,768	A	9/1989	Sinberg	379/413
4,882,728	A	11/1989	Herman	370/254
4,896,315	A	1/1990	Felker et al.	370/252
4,907,261	A	3/1990	Chapman	379/234
4,918,688	A	4/1990	Krause et al.	370/257
4,922,503	A	5/1990	Leone	370/402
4,935,926	A	6/1990	Herman	370/401
4,935,959	A	6/1990	Markovic et al.	
4,937,851	A	6/1990	Lynch et al.	379/24
4,942,604	A	7/1990	Smith et al.	379/412
4,953,055	A	8/1990	Douhet et al.	361/62
4,958,371	A	9/1990	Damoci et al.	379/377
4,961,222	A	10/1990	Johansson et al.	379/413
4,980,913	A	12/1990	Skret	713/153
4,991,123	A	2/1991	Casamassima	340/525
4,998,275	A	3/1991	Braunstein et al.	379/164
5,003,579	A	3/1991	Jones	379/93.05
5,020,100	A	5/1991	Gardiner	379/379
5,032,819	A	7/1991	Sakuragi et al.	375/257
5,034,723	A	7/1991	Maman	340/568.2
5,034,738	A	7/1991	Ishihara et al.	370/258
5,034,978	A	7/1991	Nguyen et al.	
5,051,723	A	9/1991	Long et al.	340/566
5,055,827	A	10/1991	Philipp	340/568.4
5,063,563	A	11/1991	Ikeda et al.	370/216
RE33,807	E	1/1992	Abel et al.	340/500
5,089,974	A	2/1992	Demeyer et al.	340/3.41
5,119,398	A	6/1992	Webber, Jr.	375/219
5,124,982	A	6/1992	Kaku	370/445
5,133,005	A	7/1992	Kelly et al.	379/146
5,136,580	A	8/1992	Videlock et al.	
5,142,269	A	8/1992	Mueller	
5,144,544	A	9/1992	Jenneve et al.	
5,148,144	A	9/1992	Sutterlin et al.	455/402
5,164,960	A	11/1992	Wincn et al.	375/224
5,179,291	A	1/1993	Nishikawa et al.	307/139
5,181,240	A	1/1993	Sakuragi	379/93.36
5,200,743	A	4/1993	St. Martin et al.	340/3.51
5,216,704	A *	6/1993	Williams et al.	379/93.08
5,226,120	A	7/1993	Brown et al.	709/224
5,231,375	A	7/1993	Sanders et al.	340/568.2
5,237,606	A	8/1993	Ziermann	379/413
5,243,328	A	9/1993	Lee et al.	
5,249,183	A	9/1993	Wong et al.	370/228
5,257,287	A	10/1993	Blumenthal et al.	375/292
5,260,664	A	11/1993	Graham	324/522
5,278,888	A	1/1994	Myllymaki	379/39
5,289,359	A	2/1994	Ziermann	363/21.11
5,289,458	A	2/1994	Taha	370/228
5,289,461	A	2/1994	de Nijs	370/360
5,297,141	A	3/1994	Marum	370/402
5,301,246	A	4/1994	Archibald et al.	375/222
5,311,114	A	5/1994	Sambamurthy et al.	370/296
5,311,518	A	5/1994	Takato et al.	370/359
5,333,192	A	7/1994	McGinn	379/413.04
5,347,225	A	9/1994	Graham	324/523
5,365,515	A	11/1994	Graham	
5,396,555	A	3/1995	Shibata	379/412
5,406,260	A	4/1995	Cummings et al.	340/568.2
5,414,708	A	5/1995	Webber	370/445
5,414,709	A	5/1995	Baze	370/258
5,469,437	A	11/1995	Runaldue	370/445
5,477,091	A	12/1995	Fiorina et al.	370/66
5,485,488	A	1/1996	Van Brunt et al.	375/257
5,497,460	A	3/1996	Bailey	714/39
5,578,991	A	11/1996	Scholder	
5,675,321	A	10/1997	McBride	340/568.2
5,692,917	A	12/1997	Rieb et al.	439/225
5,715,174	A	2/1998	Cotichini et al.	
5,764,647	A	6/1998	Riley	370/489
5,799,194	A	8/1998	Allen	713/320
5,821,868	A	10/1998	Kuhling	
5,854,824	A	12/1998	Bengal	379/32.04
5,929,778	A	7/1999	Asama et al.	340/10.51
5,948,007	A	9/1999	Choi et al.	710/9
5,963,557	A	10/1999	Eng	370/432
5,991,311	A *	11/1999	Long et al.	370/524
5,991,885	A	11/1999	Chang et al.	713/300
5,994,998	A	11/1999	Fisher et al.	375/258
6,000,003	A	12/1999	Allen	713/320
6,021,493	A	2/2000	Cromer et al.	713/200

6,064,305	A		5/2000	Lockyer
6,111,936	A	*	8/2000	Bremer 379/28
6,115,468	A		9/2000	De Nicolo 379/413
6,125,448	A		9/2000	Schwan et al. 713/300
6,130,894	A		10/2000	Ojard et al. 370/421
6,140,911	A		10/2000	Fisher et al. 375/258
6,147,601	A		11/2000	Sandelman et al. 340/506
6,147,603	A		11/2000	Rand 340/568.2
6,147,963	A		11/2000	Walker et al. 370/200
6,169,475	B1		1/2001	Browning 340/286.02
6,172,606	B1		1/2001	Lockyer 340/568.2
6,218,930	B1		4/2001	Katzenberg et al. 370/200
6,243,394	B1	*	6/2001	Deng 370/466
6,272,219	B1	*	8/2001	De Bruycker et al. .. 379/399.01
6,272,552	B1		8/2001	Melvin et al. 709/250
6,295,356	B1		9/2001	De Nicolo 379/413
6,314,102	B1	*	11/2001	Czerwiec et al. 370/395.6
6,344,794	B1		2/2002	Ulrich et al.
6,348,874	B1		2/2002	Cole et al. 340/825.01
6,359,906	B1	*	3/2002	Dyke et al. 370/480
6,373,851	B1		4/2002	Dadario 370/445
6,384,755	B1		5/2002	Hayden 341/120
6,473,608	B1		10/2002	Lehr et al. 455/402
6,504,825	B1		1/2003	Atkins et al. 370/254
6,522,151	B2		2/2003	Armistead et al. 324/538
6,643,566	B1		11/2003	Lehr et al. 700/286
6,658,108	B1		12/2003	Bissell et al. 379/413

FOREIGN PATENT DOCUMENTS

EP	0 357 482	B1	3/1990
EP	0 415 312	A1	3/1991
SE	WO 96/29638		9/1996
SE	WO 97/09667		3/1997
WO	PCT/IB96/00223		1/1996

OTHER PUBLICATIONS

"Integrated Services Digital Network(ISDN)", International Telecommunication Union, vol. III, Fascicle III.8, pp. 175-176 and 204-209 (Nov. 14-25, 1988).

"Token Ring Access Method", The Institute of Electrical and Electronics Engineers, Inc., 1985, 80 pages.

An Interoperable Solution for FDDI Signaling Over Shielded Twisted Pair, Advanced Micro Devices, Inc., May 21, 1991, 9 pgs.

An Interoperable Solution for FDDI Signaling Over Shielded Twisted Pair, Advanced Micro Devices, May 21, 1991, 25 pages.

Chapter I LattisNet Operation, Ethernet Connectivity Guide, 145 pages, 1991.

FDDI Metallic Media—Shielded Twisted Pair Physical Layer Medium Dependent, British Telecom, Oct. 15, 1991.

FDDI on Copper with AMD PHY, Advanced Micro Devices, 1991, 8 pgs.

IEEE Network Magazine, vol. 1, No. 1, Jan. 1987, 30 pages.

IEEE-SA Standards Board Bylaws, 3 pages, 1997.

Information Processing Systems—Fibre Distributed Data Interface (FDDI) Part 1: Token Ring Physical Layer Protocol (PHY), Global Engineering Documents, 1989, 38 pgs.

Information Processing Systems—Fibre Distributed Data Interface (FDDI) Part 3: Physical Layer Medium Dependent, Global Engineering Documents, 1989, 55 pgs.

Information Processing Systems—Fibre Distributed Data Interface (FDDI) Part 2: Token Ring Media Access Control (MAC), Global Engineering Documents, 1989, 75 pgs.

Keller, R. et al, "Performance Bottlenecks in Digital Movie Systems", Proceedings of the 4th International Workshop on Network and Operating System Support for Digital Audio and Video, Lancaster, U.K., Nov. 1993, 13 pages.

LattisNet System 3000 Ethernet Connectivity Guide, Sep. 1991, 19 pages.

LattisNet System 3000 Ethernet Connectivity Guide, Sep. 1991, 7 pages.

LattisNet System 3000 Ethernet Connectivity Guide, SynOptics Communications, Inc., Sep. 1991, 19 pages.

LattisNet System 3000 Ethernet Connectivity Guide, SynOptics Communications, Inc., Sep. 1991, 12 pages.

Lavoisard, J.L. et al, Les Installations Terminales D'Abonnes, Commutation & Transmission No. 3, 1987, pp. 35-50.

Letter of Assurance Process Flowchart, IEEE, 2 pages, 1991.

Levine, Judity, FDDI Spec Consortium, 21 pages, 1990.

Local Area Networks, Managing the Physical Layer, International Data Corporation, Mar. 1990, 36 pages, 1990.

Reference Data for Engineers: Radio, Electronics, Computer and Communications, 1989, 17 pages.

Stallings, William, Local Networks (Second Edition), 435 pages, 1990.

Stallings, William, Local Networks, An Introduction, 1990.

System Consideration for Multisegment 10 Mb/s Baseband Networks, (Section 13) and Twisted Pair Medium Attachment Unit (MAU) and Baseband Medium, Type 10BASE-T (Section 14), 33 pages, 1990.

Technical Response Center, Technical Tip, Bay Networks, 2 pages, 1995.

Token Ring Network Architecture Reference, IBM, 15 pages, 1995.

Track-It for Windows, 3 pages, 1995.

Visual Audit Pro, 2 pages, 1998.

IEEE, "Twisted-Pair Medium Attachment Unit (MAU) and Baseband Medium, Type 10BASE-T" IEEE Std. 802.3i-1990 (section 14) (1990).

IEEE, "Media Access Control (MAC) Parameters, Physical Layer, Medium Attachment Units, and Repeater for 100 Mb/s Operation, Type 100BASE-T (Clauses 21-30)" IEEE Std. 802.3u-1995.

IEEE, "Physical Coding Sublayer (PCS), Physical Medium Attachment (PMA) sublayer and baseband medium, type 1000BASE-T" IEEE Std 802.3ab-1999.

EIA/TIA 568 Standard, "Commercial Building Telecommunications Wiring Standard", Jul. 1991.

EIA/TIA Bulletin, TSB-36, "Technical Systems Bulletin Additional Cable Specifications for Unshielded Twisted Pair Cables", Nov. 1991.

EIA/TIA Bulletin, TSB40, "Additional Transmission Specifications for Unshielded Twisted Pair Connecting Hardware", Aug. 1992.

* cited by examiner

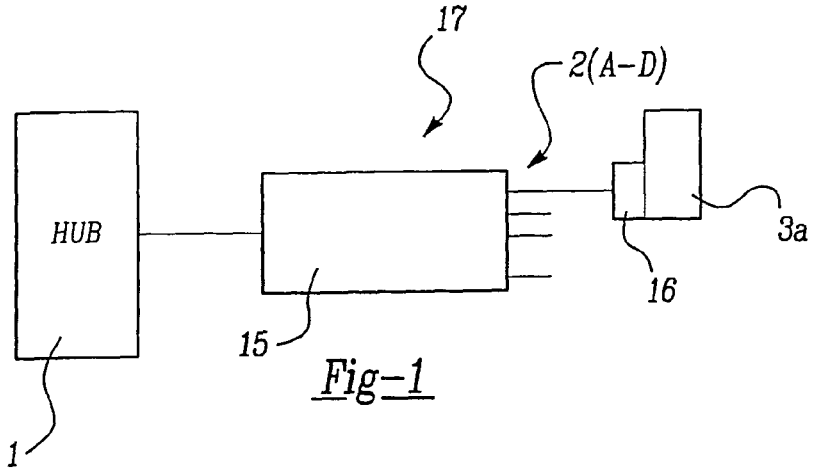


Fig-1

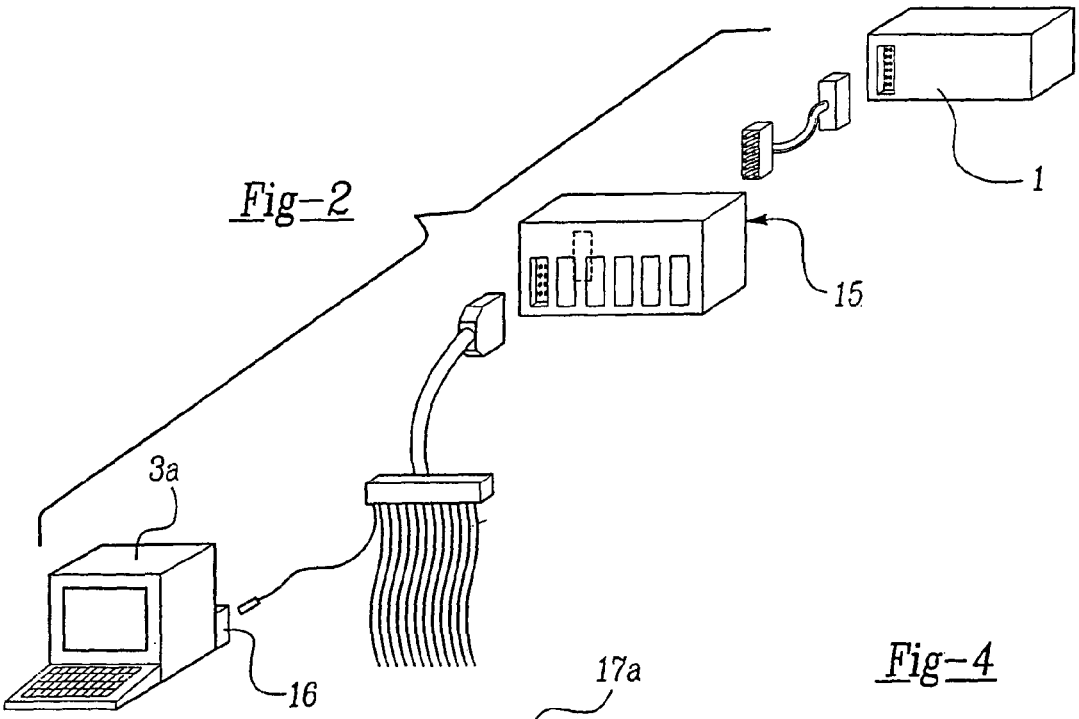
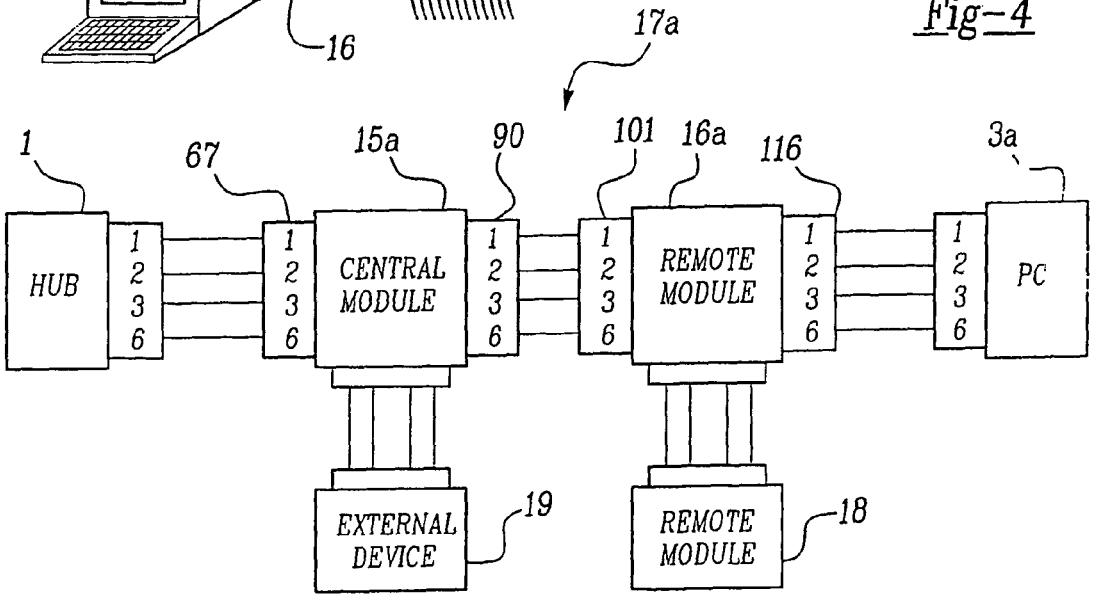


Fig-2

Fig-4



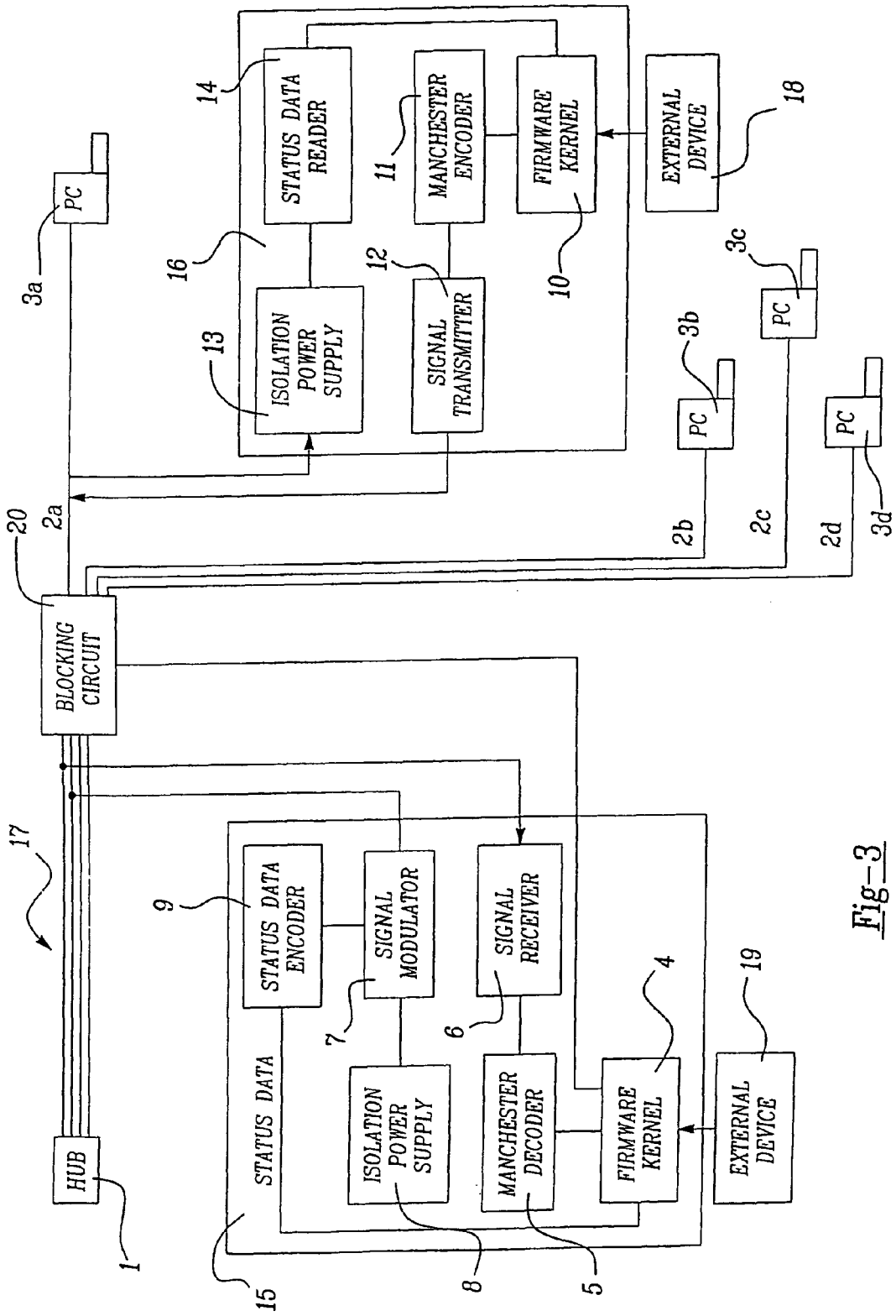
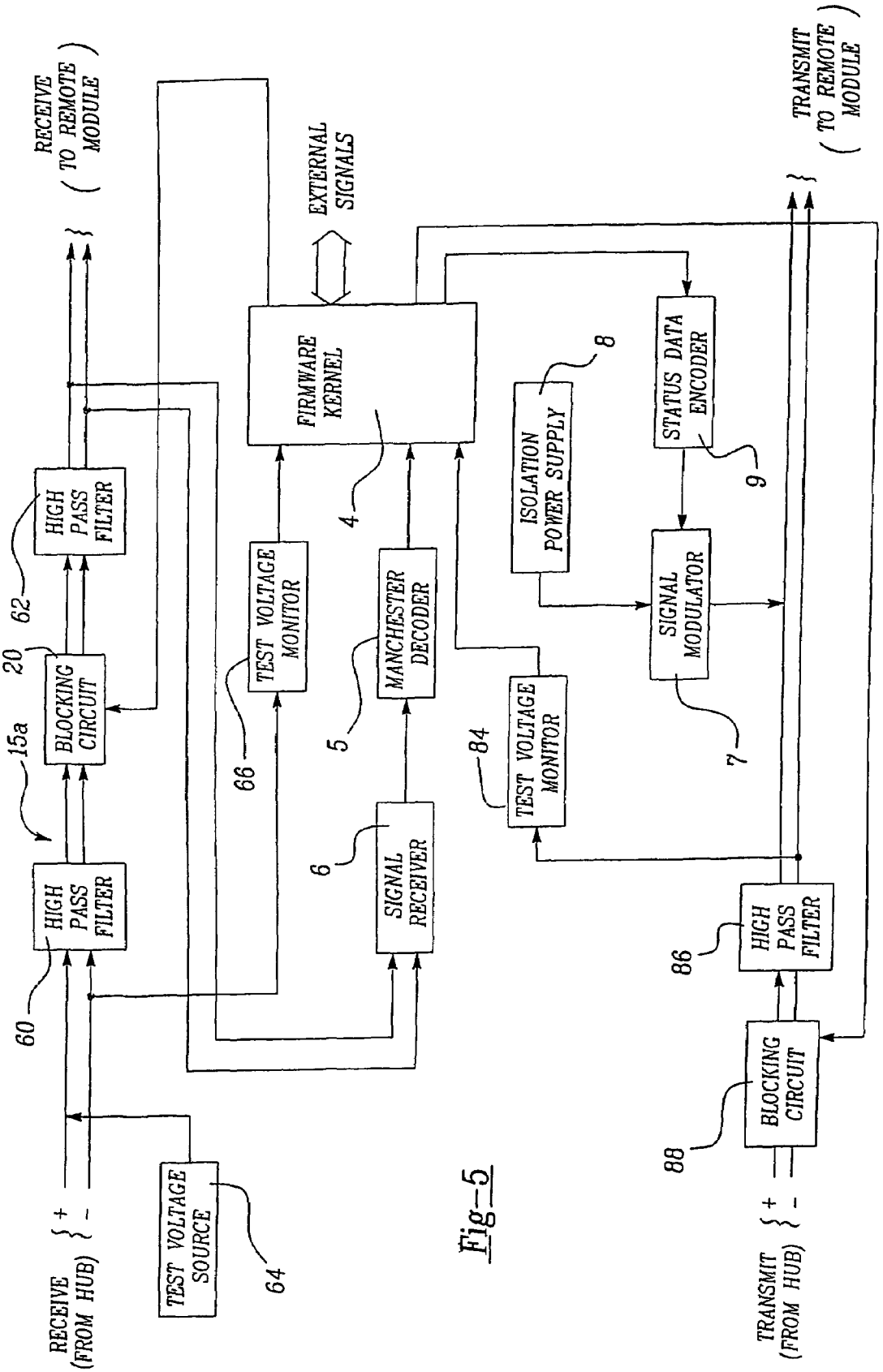

HUB
1
BLOCKING CIRCUIT
20
17
PC
3a
2a
PC
3b
2b
PC
3c
2c
PC
3d
2d
STATUS DATA READER
14
MANCHESTER ENCODER
11
FIRMWARE KERNEL
10
EXTERNAL DEVICE
18
ISOLATION POWER SUPPLY
13
SIGNAL TRANSMITTER
12
16
STATUS DATA ENCODER
9
SIGNAL MODULATOR
7
SIGNAL RECEIVER
6
STATUS DATA
15
ISOLATION POWER SUPPLY
8
MANCHESTER DECODER
5
FIRMWARE KERNEL
4
EXTERNAL DEVICE
19

Fig-3


RECEIVE (FROM HUB)
+
-
TEST VOLTAGE SOURCE
64
60
HIGH PASS FILTER
15a
20
BLOCKING CIRCUIT
62
HIGH PASS FILTER
RECEIVE (TO REMOTE MODULE)
66
TEST VOLTAGE MONITOR
6
SIGNAL RECEIVER
5
MANCHESTER DECODER
EXTERNAL SIGNALS
4
FIRMWARE KERNEL
84
TEST VOLTAGE MONITOR
8
ISOLATION POWER SUPPLY
7
SIGNAL MODULATOR
9
STATUS DATA ENCODER
TRANSMIT (TO REMOTE MODULE)
86
HIGH PASS FILTER
88
BLOCKING CIRCUIT
TRANSMIT (FROM HUB)
+
-

Fig—5

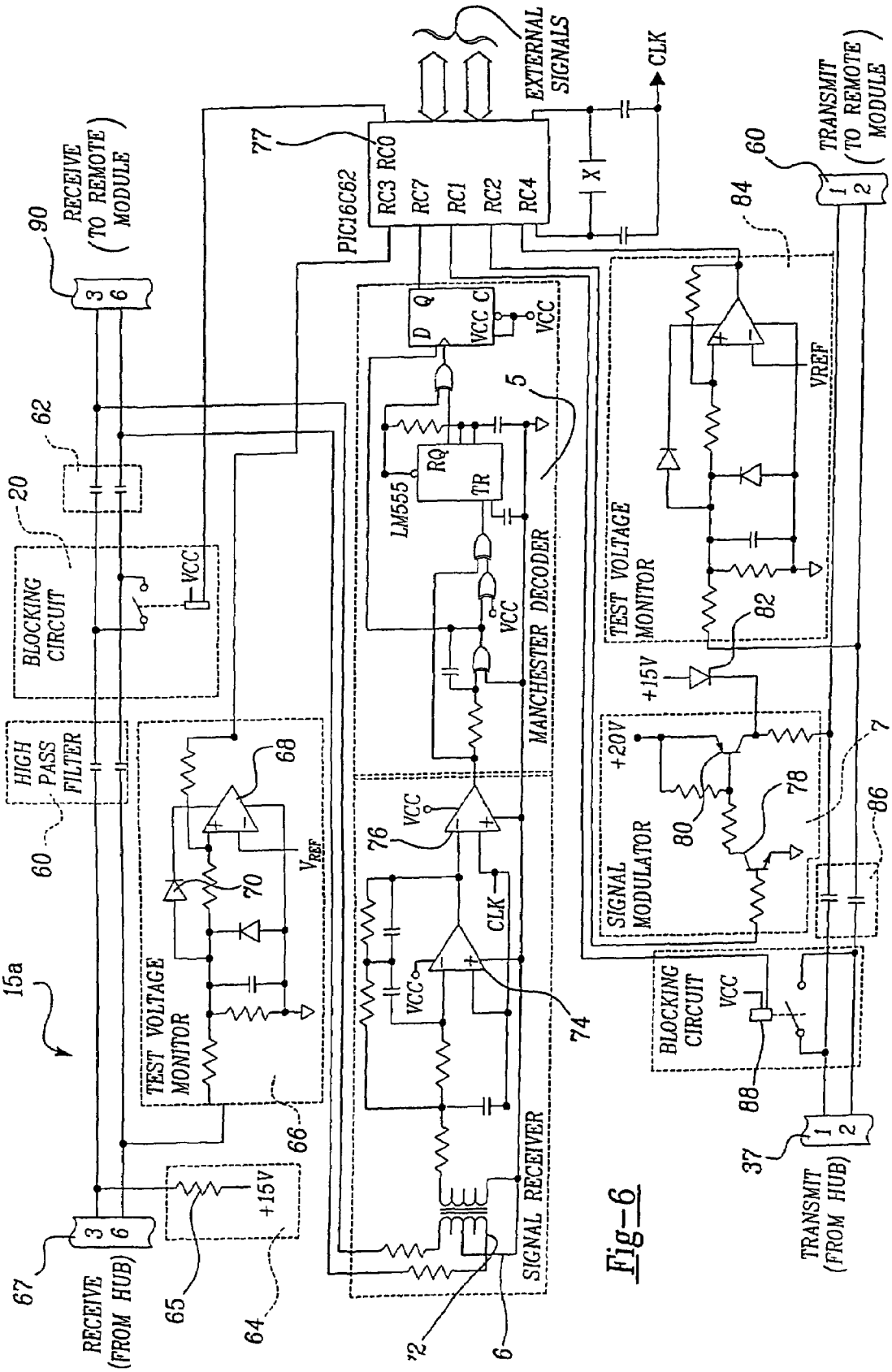
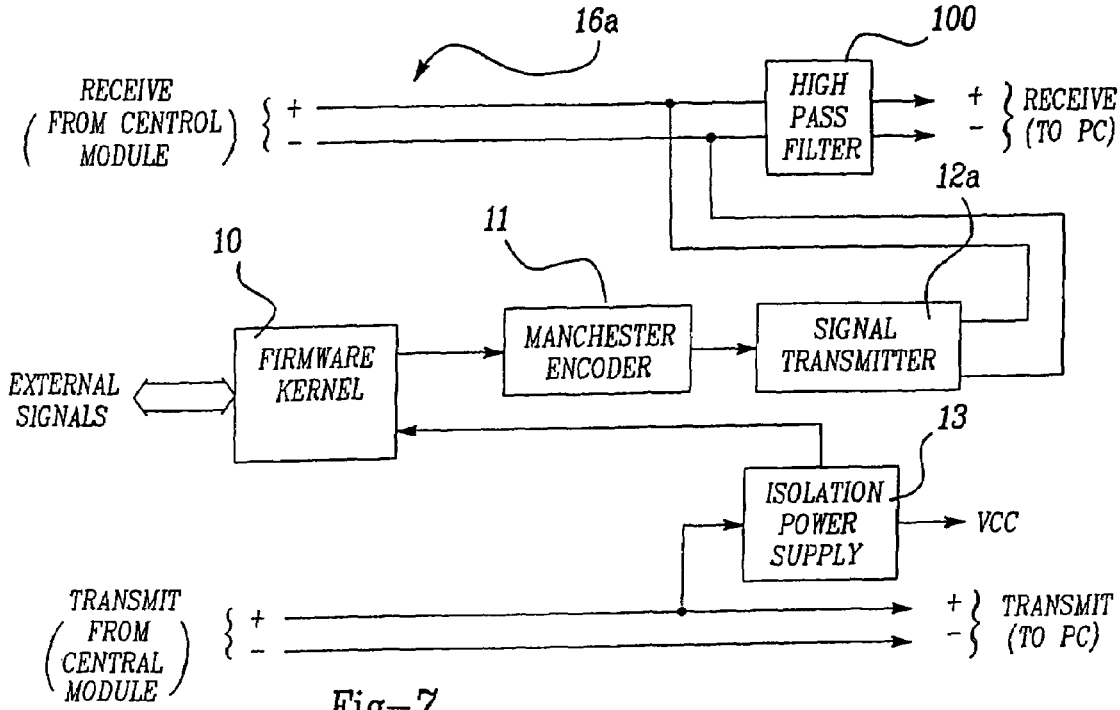
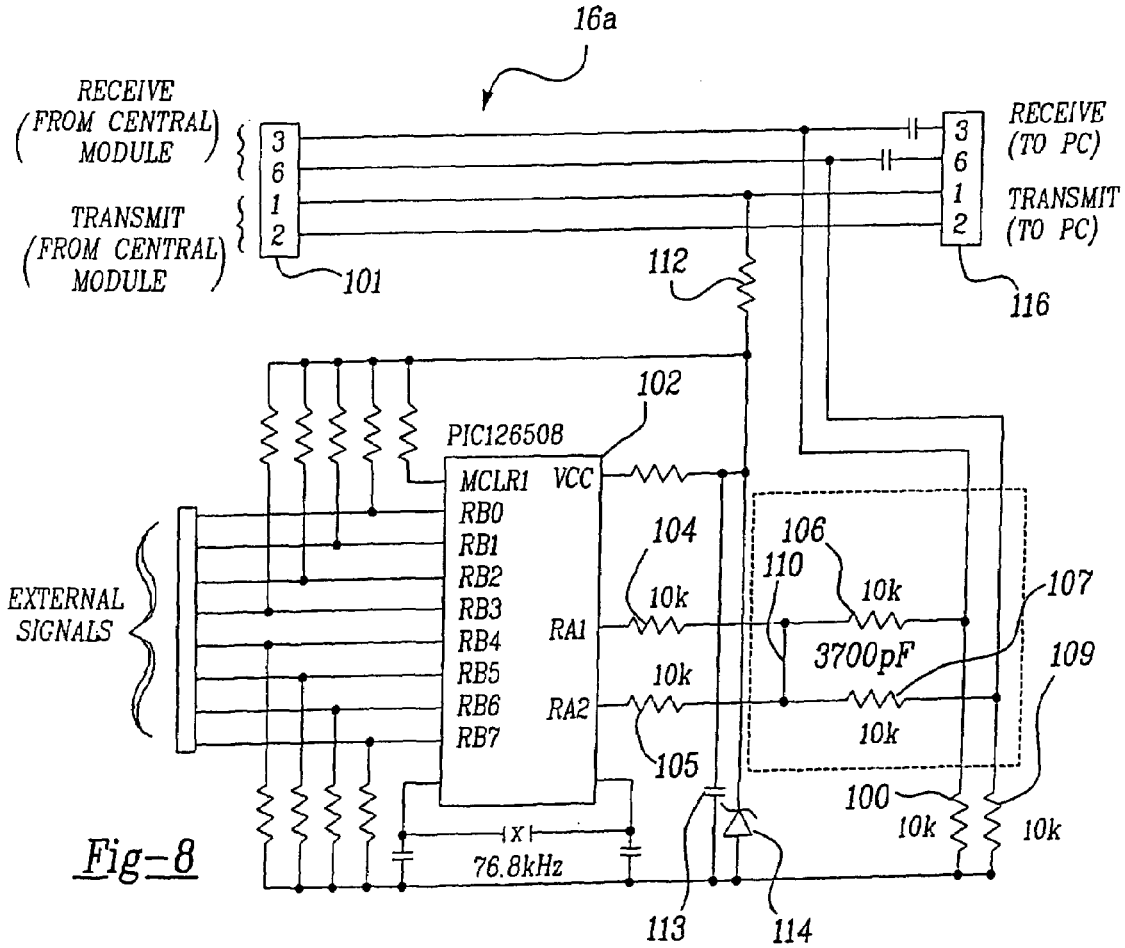

EXTERNAL SIGNALS
CLK
X
PIC16C62
RC3 RC0
RC7
RC1
RC2
RC4
77
RECEIVE (TO REMOTE MODULE)
90
TRANSMIT (TO REMOTE MODULE)
60
84
62
20
BLOCKING CIRCUIT
VCC
HIGH PASS FILTER
60
D Q
VCC C
VCC
5
RQ
TR
LM555
MANCHESTER DECODER
VCC
VCC
TEST VOLTAGE MONITOR
VREF
82
+15V
+20V
7
SIGNAL MODULATOR
80
78
86
68
VREF
70
TEST VOLTAGE MONITOR
66
15a
76
VCC
CLK
VCC
74
BLOCKING CIRCUIT
VCC
88
67
RECEIVE (FROM HUB)
65
+15V
64
72
6
SIGNAL RECEIVER
37
TRANSMIT (FROM HUB)

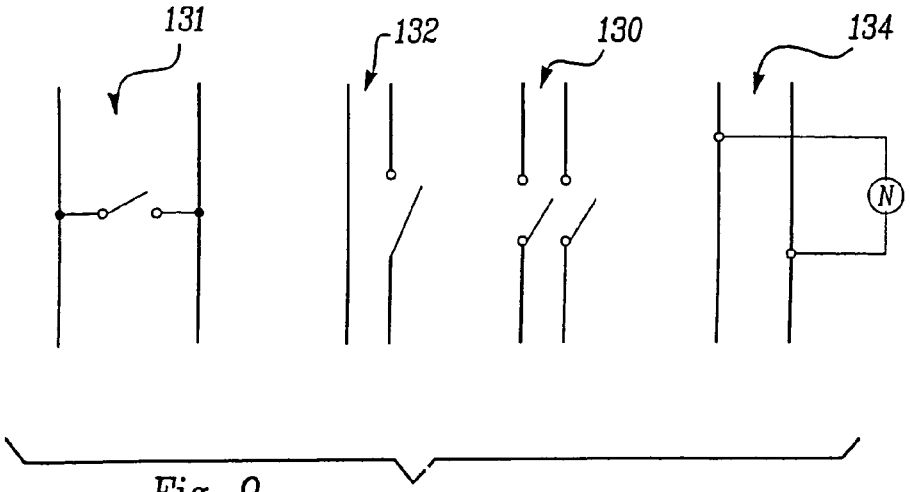
Fig-6


16a
100
RECEIVE
(FROM CENTROL
MODULE)
+
-
HIGH
PASS
FILTER
+
-
RECEIVE
(TO PC)
12a
11
10
EXTERNAL
SIGNALS
FIRMWARE
KERNEL
MANCHESTER
ENCODER
SIGNAL
TRANSMITTER
13
ISOLATION
POWER
SUPPLY
VCC
TRANSMIT
(FROM
CENTRAL
MODULE)
+
-
TRANSMIT
(TO PC)

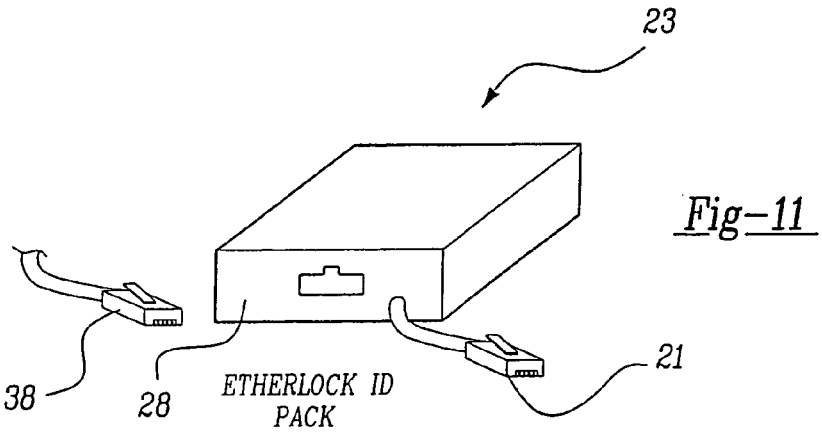
Fig–7


16a
RECEIVE
(FROM CENTRAL
MODULE)
TRANSMIT
(FROM CENTRAL
MODULE)
3
6
1
2
101
RECEIVE
(TO PC)
TRANSMIT
(TO PC)
116
112
102
PIC126508
MCLR1
VCC
RB0
RB1
RB2
RB3
RB4
RB5
RB6
RB7
RA1
RA2
104
10k
10k
106
110
10k
3700pF
10k
107
109
EXTERNAL
SIGNALS
105
100
10k
10k
X
76.8kHz
113
114

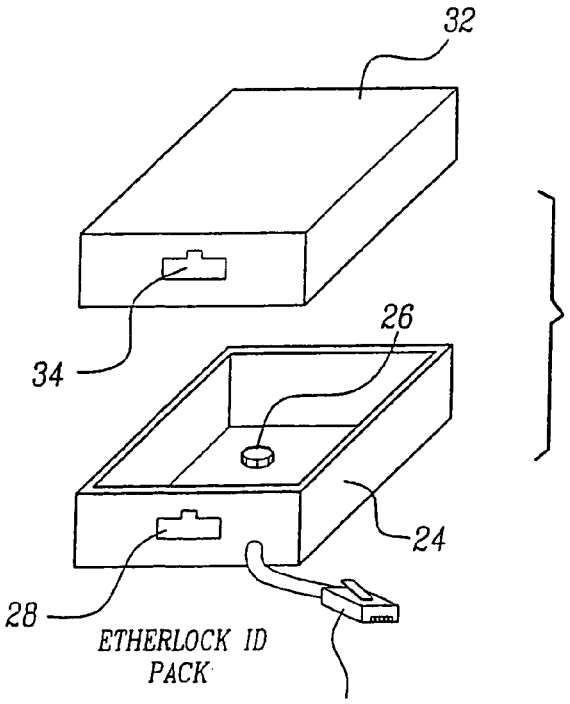
Fig–8



Fig–9



Fig–11



Fig–12

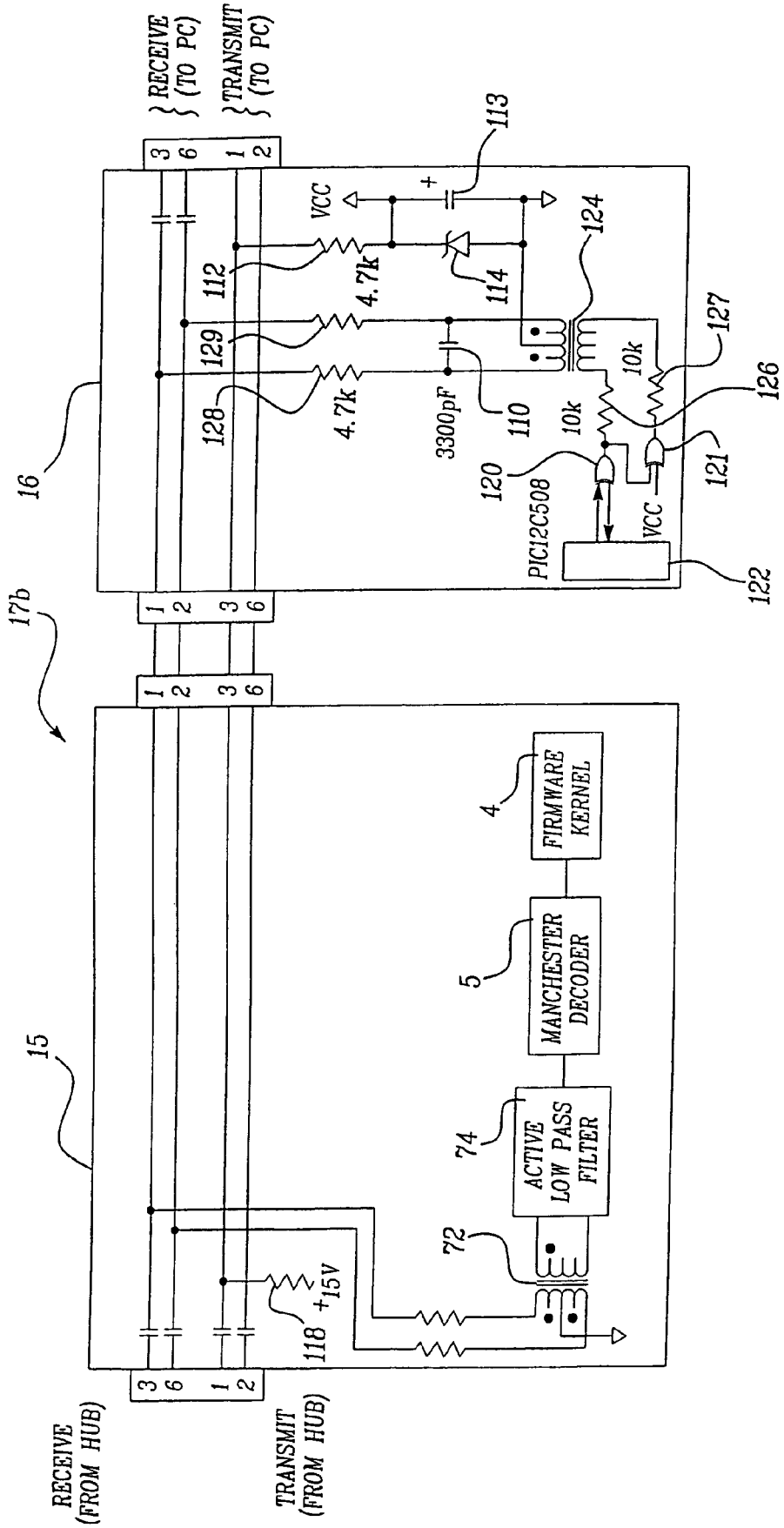

RECEIVE (TO PC)
TRANSMIT (TO PC)
3 6 1 2
113
VCC
+
124
112
4.7k
114
129
127
10k
126
128
4.7k
3300pF
110
10k
120
121
PIC12C508
VCC
122
16
17b
1 2 3 6
4
FIRMWARE KERNEL
5
MANCHESTER DECODER
74
ACTIVE LOW PASS FILTER
72
15
+15V
118
RECEIVE (FROM HUB)
TRANSMIT (FROM HUB)

Fig-10

Fig-13

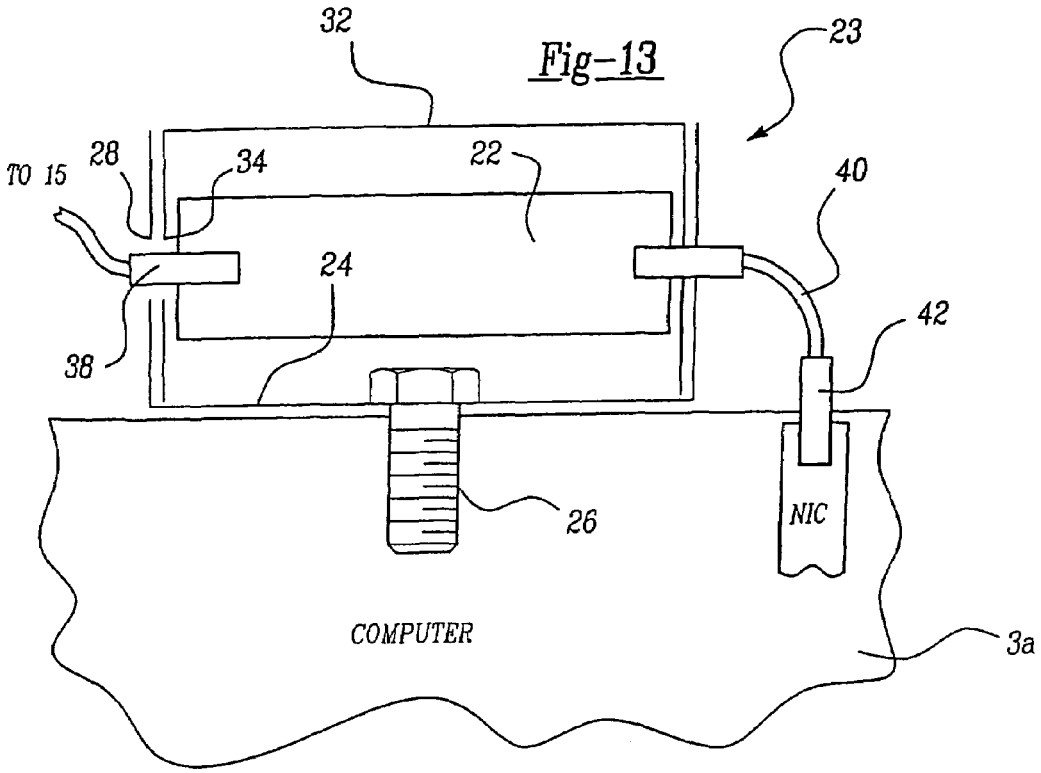
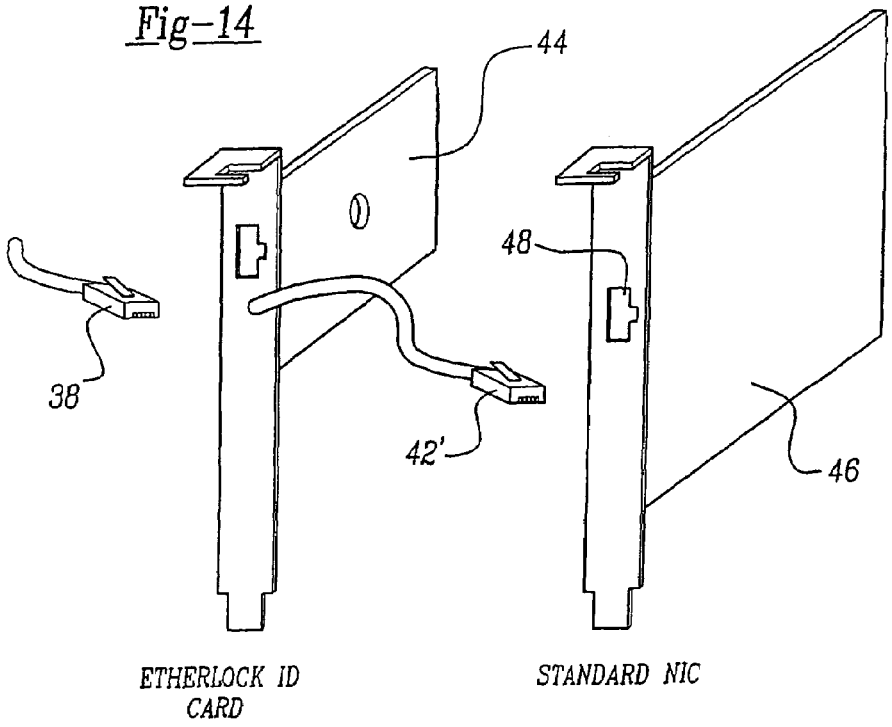
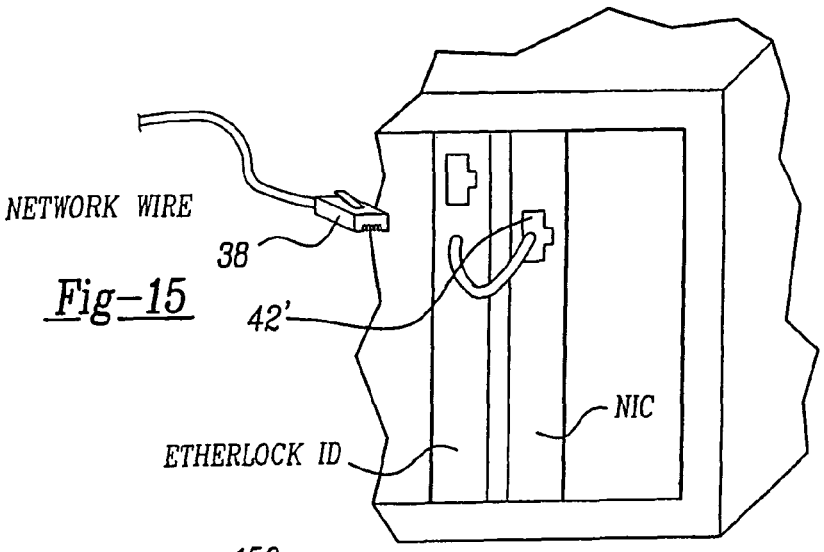

32
23
TO 15
28
34
22
40
24
42
38
26
NIC
COMPUTER
3a

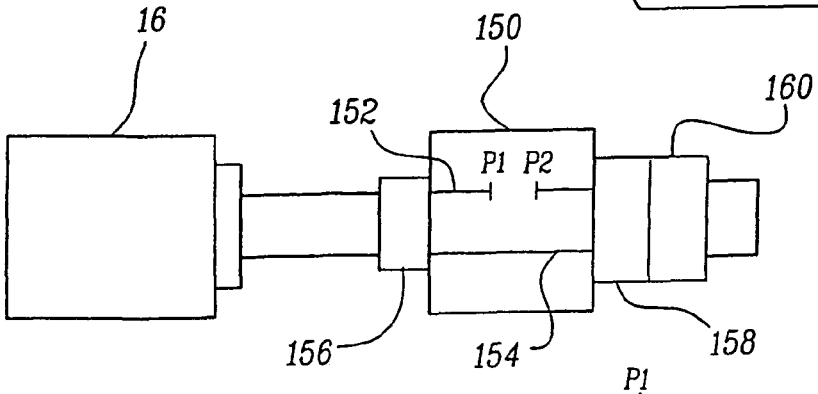
Fig-14

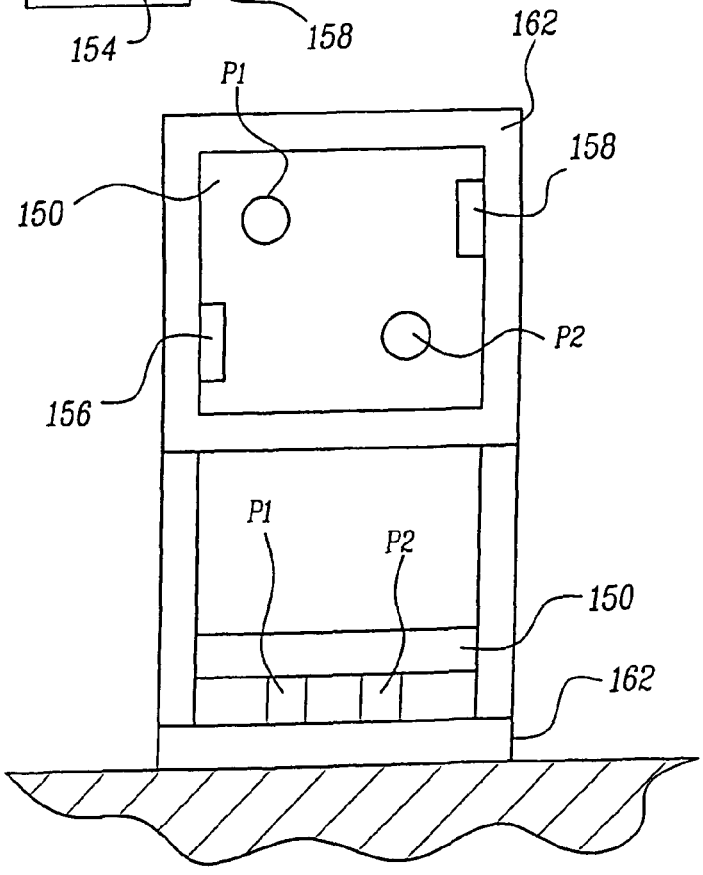

44
48
38
42'
46
ETHERLOCK ID CARD
STANDARD NIC



Fig–15

Fig–16





Fig–17

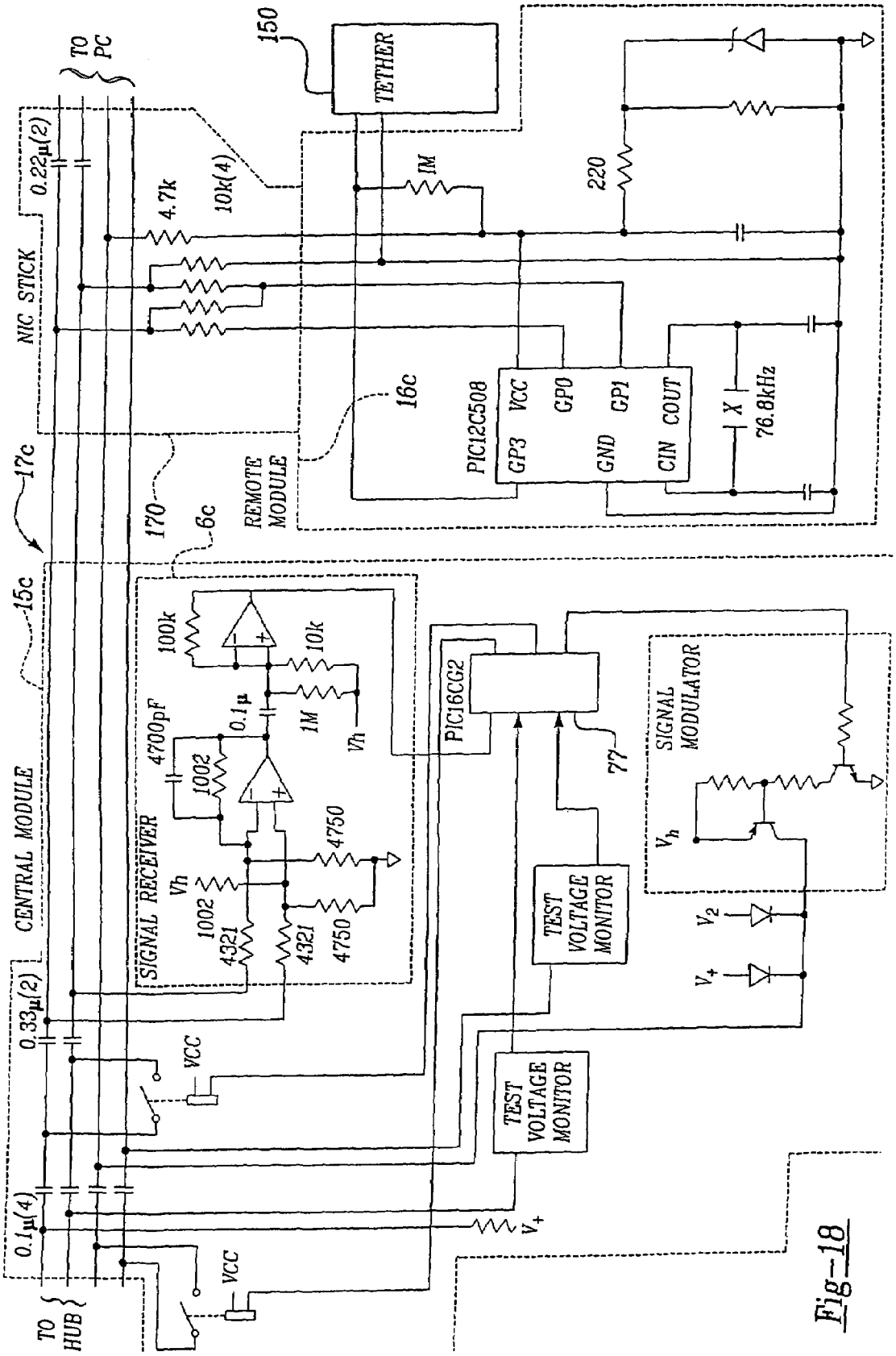

TO PC
150
TETHER
0.22μ(2)
4.7k
10k(4)
1M
220
NIC STICK
16c
PIC12C508
VCC
GP0
GP1
COUT
GP3
GND
CIN
X
76.8kHz
REMOTE MODULE
17c
170
6c
15c
CENTRAL MODULE
100k
10k
0.1μ
1M
Vh
4700pF
1002
4750
SIGNAL RECEIVER
4321
PIC16CG2
77
SIGNAL MODULATOR
TEST VOLTAGE MONITOR
V2
V+
0.33μ(2)
VCC
0.1μ(4)
TO HUB

Fig-18

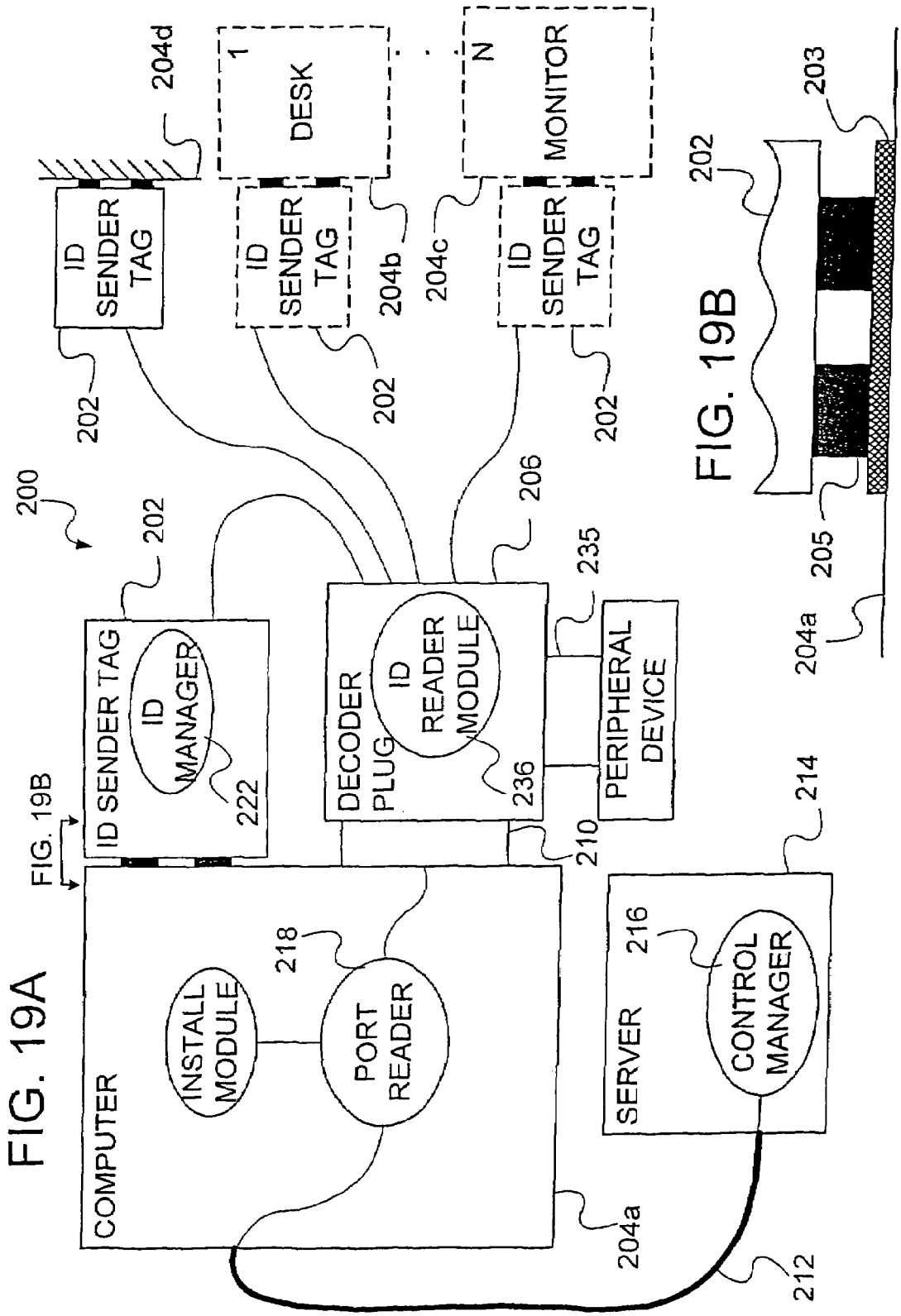


FIG. 19A
200
202
ID SENDER TAG
ID MANAGER
222
FIG. 19B
COMPUTER
INSTALL MODULE
218
PORT READER
204a
DECODER PLUG
ID READER MODULE
236
206
235
PERIPHERAL DEVICE
210
SERVER
216
CONTROL MANAGER
214
212
ID SENDER TAG
202
204d
1
DESK
204b
N
MONITOR
204c
203
205

Fig. 20

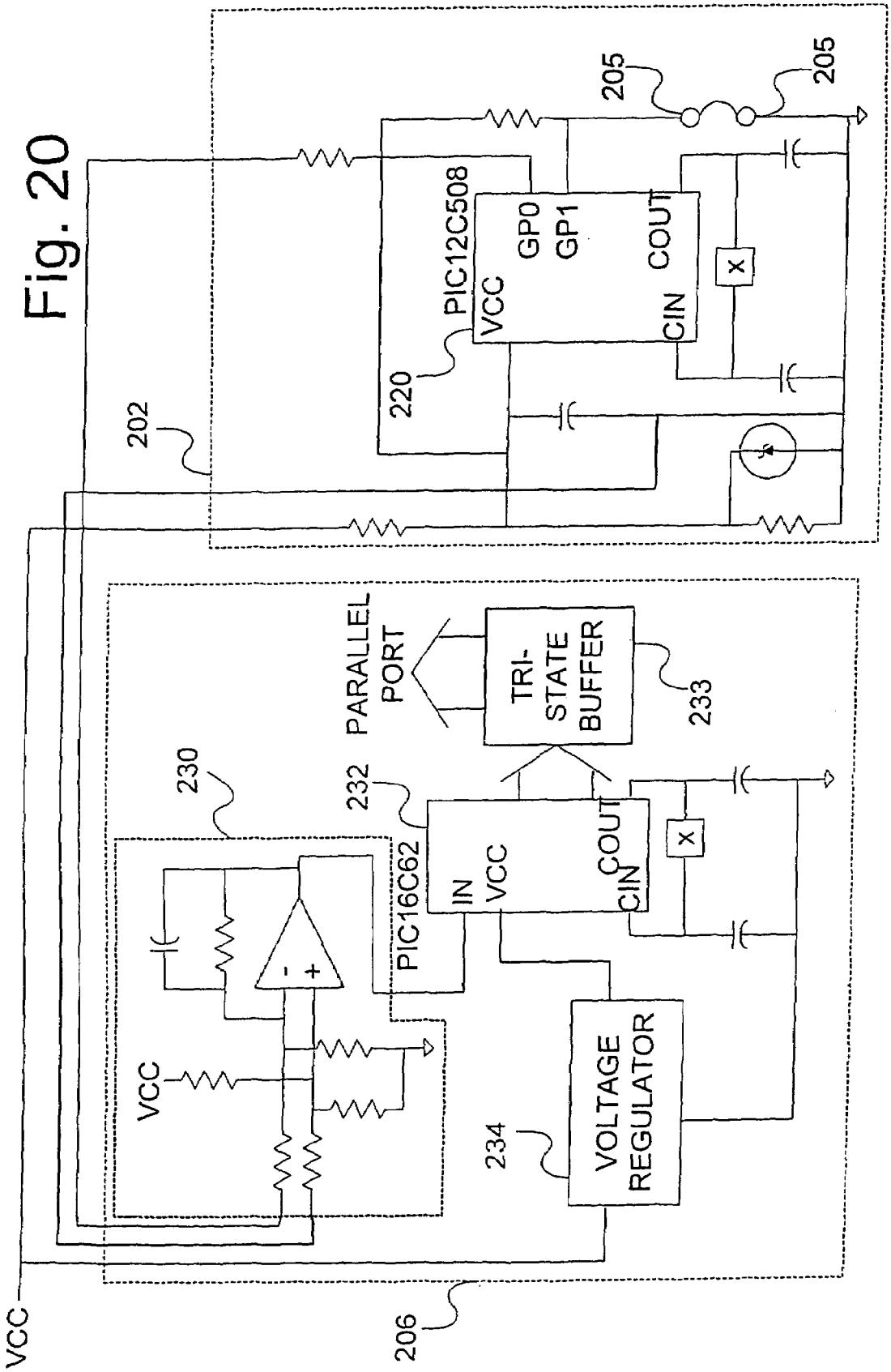

205
205
PIC12C508
GP0
GP1
COUT
VCC
CIN
220
202
PARALLEL PORT
TRI-STATE BUFFER
233
230
232
PIC16C62
IN
VCC
COUT
CIN
VCC
234
VOLTAGE REGULATOR
206
VCC

Fig. 21

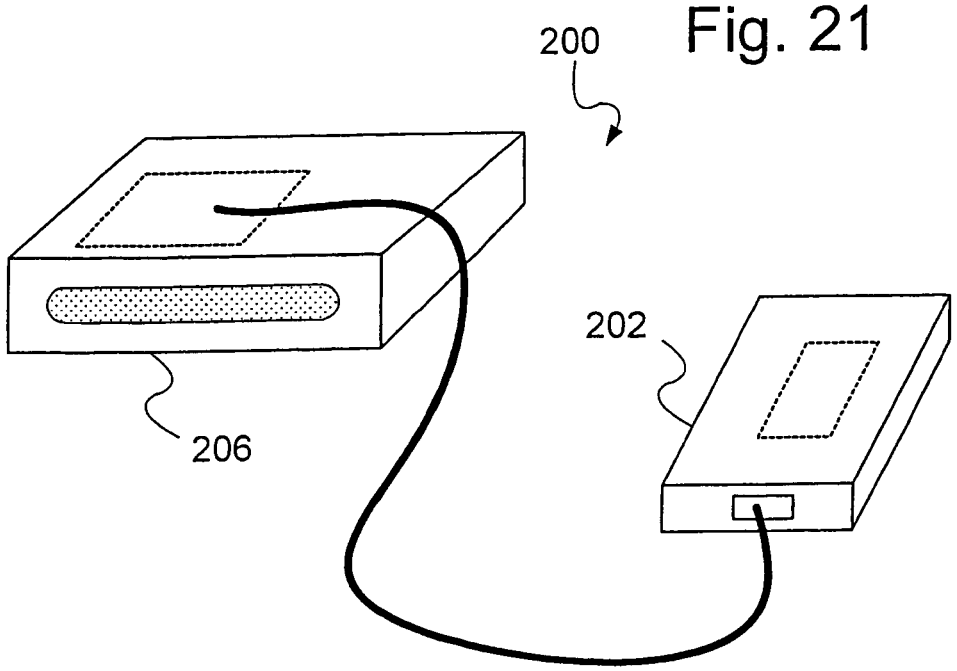
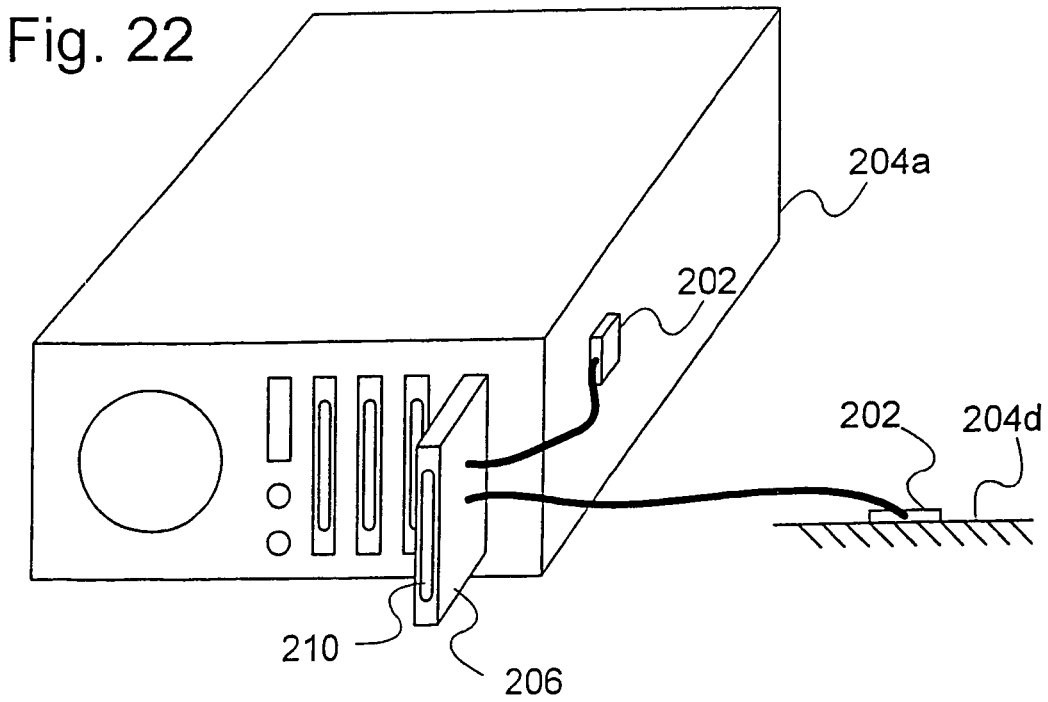


Fig. 22



SYSTEM FOR COMMUNICATING WITH ELECTRONIC EQUIPMENT

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 09/370,430 filed Aug. 9, 1999 which is a continuation-in-part under 35U.S.C.§111 and §120 of international application PCT/US99/07846, filed Apr. 8, 1999, designating, inter alia, the United States, and which claims the benefit of U.S. provisional application No. 60/081279 filed Apr. 10, 1998.

BACKGROUND OF THE INVENTION

1.Technical Field

This invention relates generally to computer networks and, more particularly, to a network management and security system for managing, tracking, and identifying remotely located electronic equipment on a network.

2. Discussion

Over the last several years, one of the largest problems in managing the computerized office environment has been identified as controlling the Total Cost of Ownership, or TCO, of the office computer. Controlling TCO includes not only the cost of the asset but also all costs associated with that asset, such as support costs, software costs, and costs due to loss or theft, including hardware, software, and most importantly, information.

An aspect of the support costs of TCO is asset movement. Today, many employees have more than one computer. When that employee is moved to another location, the assets must be moved as well. A typical organization can have as much as 40% of its employees move from one location to another over the course of a year. When these movements occur daily, tracking each asset over time is nearly impossible. There is also the unauthorized movement of assets, such as moving an asset from an employee's office to his or her associated lab area. In addition to these physical movements, the asset may also be changed over time through hardware and software modifications. Even if an asset is successfully tracked over a period of time, the asset may not be the same at the end of the period. Due to this constant asset relocation and reorganization, an organization may not always know where all of its assets are located. In fact, it is very likely that a company may not even know how many assets they own or if those assets are still in their possession. Additionally, an organization that desires to send a message to all of the assets within a particular physical area is limited to relying on databases that correlate the network identification of an asset to where that asset should be located, not where the asset actually is located. Previous attempts to provide asset tracking and management have relied on software solutions that have proven to be fundamentally flawed. Asset tracking and management software is limited in a number of important areas. It is generally incapable of detecting the electrical connection status of equipment, it cannot detect the physical location of equipment, the identifying name of equipment is not permanent, and the monitored assets must be powered-up.

Therefore, a method for permanently identifying an asset by attaching an external or internal device to the asset and communicating with that device using existing network wiring or cabling is desirable. Also, it is desirable to communicate with an asset based upon the physical location of the asset. Additionally, a method of determining when an asset is being removed or added to the network is desirable. It would also be desirable to communicate with the device without requiring the device or the asset to be connected to alternating current (AC) power. Such a device would allow a company to track its assets, locate any given asset, and count the total number of identified assets at any given time, thus significantly reducing its TCO of identified assets.

One method that attempted to control the hardware theft aspect of TCO is disclosed in U.S. Pat. No. 5,406,260 issued to Cummings et. al, (hereby incorporated by reference) which discusses a means of detecting the unauthorized removal of a networked device by injecting a low current power signal into each existing communications link. A sensor monitors the returning current flow and can thereby detect a removal of the equipment. This method provides a means to monitor the connection status of any networked electronic device thus providing an effective theft detection/deterrent system.

It would, however, be desirable to provide a further means in which a networked device may also be identified by a unique identification number using the existing network wiring or cabling as a means of communicating this information back to a central location. More particularly, it is desirable to provide a means for identification that feasibly employs the same cable (and, if desired, the same wires in the cable) that normally carries high frequency data communications in an existing network. In addition, it is desirable to provide an identification system that is easily and inexpensively implemented in an existing network system.

The theft of information is a further aspect of TCO. Today, the most important resources a company has are its employees and the information that they create and accumulate. Information that is available on a company's internal network can range from personnel files and corporate business plans to research and development efforts related to new products. Restricting access to sensitive or confidential information such as personnel files is a high priority for all companies. The use of passwords and limiting access to certain types of information to particular computer stations are typical methods that companies employ to protect information. These passive methods of protecting company information are sufficient to prevent technically unknowledgeable people from gaining access to protected information. However, these methods are usually unable to protect information from a technically knowledgeable person with specialized electronic equipment. The existence of an unauthorized device connected to the company network may indicate the presence of someone with electronic equipment that has the capability to defeat a company's internal security measures. A method of blocking communications with such a device connected to a network is desirable. Further, automatically blocking communications with an unauthorized device is desirable. An active system that interrogates the devices connected to a network and blocks communications with unauthorized devices would provide enhanced security for sensitive information.

A further aspect of support costs is the cost associated with utilization of network bandwidth. Today, the bandwidth of most networks is being constantly increased to meet the increasing need to transmit large quantities of data. In order to provide the required bandwidth costly hardware upgrades must be purchased resulting in an increase in the TCO. To reduce the need for hardware upgrades the use of available network bandwidth is dedicated to data that is required for the operation of application programs. Using valuable network bandwidth to provide a means of identifying assets would either limit the availability of bandwidth for application programs or require the purchase of new hardware. Additionally, using network bandwidth for asset identification would limit the identification system to operating only when the asset has

AC power applied. Assemblies within the asset would have to be operational in order to transmit data over the network. Requiring power to be applied to every monitored asset would limit the capability to identify all the assets connected to a network at any particular time. Therefore, it is desirable to provide a means for asset identification that does not use existing network bandwidth. Such a device would more fully utilize existing network resources without increasing the TCO associated with network bandwidth.

SUMMARY OF THE INVENTION

In accordance with the teachings of the present invention, a communication system is provided for generating and monitoring data over a pre-existing wiring or cables that connect pieces of networked computer equipment to a network. The system includes a communication device or remote module attached to the electronic equipment that transmits information to a central module by impressing a low frequency signal on the wires of the cable. A receiver in the central module monitors the low frequency data to determine the transmitted information from the electronic equipment. The communication device may also be powered by a low current power signal from the central module. The power signal to the communication device may also be fluctuated to provide useful information, such as status information, to the communication device. Relocation of the electronic equipment with the attached communication device to another location on the network is detected immediately and may be used to update a database. This invention is particularly adapted to be used with an existing Ethernet communications link or equivalents thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the present invention will become apparent to those skilled in the art upon reading the following detailed description and upon reference to the drawings in which:

FIG. **1** is a general block diagram that illustrates a network that includes a communication system in accordance with a first embodiment of the present invention;

FIG. **2** is an exploded perspective view that illustrates installation of the central module into an existing computer network in accordance with the first embodiment of the present invention;

FIG. **3** is a block diagram that illustrates the first embodiment of the present invention;

FIG. **4** is an interconnection diagram that illustrates a second embodiment of the present invention;

FIG. **5** is a block diagram that illustrates a central module made in accordance with the teachings of the present invention;

FIG. **6** is a detailed schematic diagram of the central module in accordance with the second embodiment of the present invention;

FIG. **7** is a block diagram that illustrates a remote module made in accordance with the teachings of the present invention;

FIG. **8** is a detailed schematic diagram that illustrates a central module in accordance with the second embodiment of the present invention;

FIG. **9** is a diagram that illustrates alternate circuits for blocking communications in accordance with an embodiment of the present invention;

FIG. **10** is a detailed schematic diagram which illustrates a remote module and a central receiver module coupled to a network in accordance with the third embodiment of the present invention;

FIG. **11** is a perspective view of one embodiment of the hardware for the remote module;

FIG. **12** is an exploded perspective view of the hardware of FIG. **11**;

FIG. **13** is a cross-sectional view of the hardware shown mounted to a computer;

FIG. **14** is a perspective view of an alternative embodiment of the hardware for the remote module;

FIG. **15** illustrates the installation of the hardware of FIG. **14** into a computer;

FIG. **16** is a schematic representation of an electronic tether in accordance with the fourth embodiment;

FIG. **17** is a cross-sectional view of an electronic tether used in connection with the fourth embodiment;

FIG. **18** is a schematic representation of circuitry for the fourth embodiment;

FIG. **19***a* is a block diagram that illustrates a system for electronically identifying an object made in accordance with the teachings of the present invention;

FIG. **19***b* is a cross-sectional view of an ID sender tag used in connection with the system for electronically identifying an object;

FIG. **20** is a schematic representation of circuitry used in a system for electronically identifying an object;

FIG. **21** is a perspective view that illustrates installation of an ID sender tag and decoder plug; and

FIG. **22** is a perspective view that illustrates an ID sender tag and decoder plug interconnected by a serial bus.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Four embodiments of the invention are illustrated within this specification. The first embodiment illustrates the general teachings of the invention, whereas the second, third, and fourth embodiments depict specific implementations of the teachings. Turning now to FIGS. **1**, **2** and **3**, a first embodiment of a central module **15** and remote module **16** system is provided therein for achieving identification of electronic computer equipment associated with a computer network **17**. Although, the first embodiment depicts merely communicating equipment identification information, the principles of the invention may be readily extended to include the communication of more general information such as identification of the equipment processor type and the equipment harddrive capacity. In general, the central module **15** monitors remote module circuitry **16** that may be permanently attached to remotely located electronic workstations such as personal computers **3**A through **3**D over the computer network **17**. The communication system **15** and **16** described herein is particularly adapted to be easily implemented in conjunction with an existing computer network **17** while realizing minimal interference to the computer network. In addition to being implemented from the hub of a network to remotely located PCs, the invention can be applied to other elements of an office environment such as telephones, fax machines, robots, and printers. The invention is particularly suitable for being incorporated into a patchpanel. The asset aware patchpanel would then be capable of identifying the existence and location of network assets without power being applied to the assets.

Remotely located personal computers **3**A through **3**D are each connected to the computer network **17** so as to provide widespread remote user access to the computer network **17**.

The remotely located personal computers **3**A through **3**D are shown connected to hub **1** via data communication links **2**A through **2**D. Data communication links **2**A through **2**D are, for example, conventional multi-wire cables that include a plurality of transmit and receive data communication links (sometimes referred to herein as wires or lines) for communicating information between each of remotely located computers **3**A through **3**D and other communication devices on the network such as other computers and file servers (not shown).

The invention described herein is particularly suited to be implemented in conjunction with a computer network **17** which preferably employs a conventional wiring approach of the type which may include twisted pair wiring such as Ethernet, Token Ring, or ATM. Wiring schemes similar to Ethernet are commonly employed to provide data communication links for electronic computer equipment. In accordance with conventional wiring or cabling approaches, data communication links **2**A-**2**D generally include a pair of transmit wires (not shown) as well as a pair of receive wires (not shown) connected to each of personal computers **3**A through **3**D. The cable may include other wires, as well. Each pair of transmit and receive wires are internally coupled to an associated personal computer via two windings of an internally located isolation transformer (not shown). Each pair of transmit wires and each pair of receive wires thereby form a current loop through one of the personal computers **3**A through **3**D which is advantageously employed in accordance with the approach described herein.

The central module **15** includes an isolation power supply **8** (see FIG. **3**) which supplies a continuous direct current (DC) power supply to each of current loops **2**A through **2**D. The DC power supply has a low current preferably on the order of magnitude of about 1 mA. The isolation power supply **8** includes an input terminal for receiving a low voltage signal V_{LV} which has a magnitude of approximately fifteen (15) volts. The present embodiment of the invention sources DC current from the 15 volt source to the remote modules **16**. However, it is within the scope of the invention to provide other voltage levels such as 3V dc, and 20V dc. Although the present embodiment sources current for the immediate power needs of the remote module, it is also within the scope of the invention to supply current to charge a battery, capacitor bank, or other energy storage device that powers the remote module. Additionally, powering the remote module from some other source such as a primary battery, rechargeable battery or capacitor bank that receives energy from a source other than the central module is within the scope of the invention.

The power generated by isolation power supply **8** is passed through signal modulator **7** which can slightly alter the voltage supplied by isolation power supply **8** based upon status data provided by the status data encoder **9**. Status data encoder **9** receives its status data from the firmware kernel **4**. Signal modulator **7** inserts this low power supply across the transmit and receive lines or into either the transmit lines or the receive lines in order to supply the remote module **16** with both status information and power. The scope of the invention includes transmitting status information as a single bit or as a pulse train. Types of transmitted status information include whether the protection circuit is active, date, time, and port location. It is also within the scope of the invention to encode the status data using methods such as single bit on/off, Manchester, 4B/5B, and Frequency Shift Keying (FSK).

Isolation power supply **13** draws power for the remote module **16** and provides status information that was encoded into the power supply signal by signal modulator **7** within the central module **15**. This status information is in turn passed over to the firmware kernel **10** of the remote module **16** by way of the status data reader **14**.

Firmware kernel **10** provides a preprogrammed unique identification number to Manchester encoder **11** in order to reliably traverse the data communication link or cable **2**A. The Manchester encoder then passes this encoded number to signal transmitter **12** which sends the encoded number across the data communication link **2**A by altering the total current draw of the remote module **16**. Although the present embodiment of the invention uses Manchester encoding, the principles of the invention may be readily extended to other encoding techniques such as Frequency Shift Keying, 4B/5B, PAM5×5, 8B/6T, Polar NRZ, and Bipolar. Additionally, waveshaping the encoded signal with techniques such as MLT-3 is within the scope of the invention. In addition to transmitting an identification number the firmware kernel **10** may also elect to send additional information such as confirmation of the status information or additional data provided by an external device **18**, such as the computer **3**A to which the remote module **16** is attached.

The information sent from the remote module **16** is received by the signal receiver **6** within the central module **15**, decoded by Manchester decoder **5**, and passed on to the firmware kernel **4**. The firmware kernel may now pass this received information on to an external device **19**, such as a computer responsible for asset tracking.

Kernel **4** may optionally provide a blocking signal to blocking circuit **20** to deny, to an unauthorized computer, access to the network information via hub **1**. For example, if someone uses a laptop to attempt to plug into the network, the central module **15** detects the absence of the proper identification code from the laptop and, as noted before, kernel **4** would issue a suitable signal to blocking circuit **20** to prevent access to the network information and also generate an alarm. Furthermore, if the potential thief later disconnects protected equipment from the network, this action is also detected and an alarm can be generated. Although the present embodiment illustrates the blocking function as shorting the data lines together **131** (see FIG. **9**), it is within the scope of the invention to implement blocking by other means, such as opening both lines of the transmit or receive data lines **130**, opening one of the data lines **132**, and transmitting noise onto the data lines **134**.

FIGS. **4**-**8** illustrate a second embodiment of the invention which generally differs from the first embodiment by having circuitry that transmits a modulated signal directly to central module **15***a* from remote module **16***a*. In the first embodiment current sourced from central module **15** to remote module **16** is modulated within remote module **16** and then returned to central module **16**. In addition, the second embodiment does not have a status data reader **14** in remote module **16***a*, but does additionally include test voltage source **64** and test voltage monitor 66 and 84 pairs in the central module **15***a*. Referring to FIG. **4** a network **17***a* that includes the communication system is shown. Hub **1** connects to central module **15***a*, which connects to remote module **16***a*, which connects to PC **3**A. Also connected to central module **15***a* and remote module **16** are external devices **19** and **18**. Although the central module **15***a* and remote module **16***a* are each shown connected to a single external device it is within the scope of the invention to connect multiple external devices to the modules **15***a* and **16***a*. Some of the external devices that are envisioned include motion detectors and glass breakage detectors.

Referring to FIGS. **5** and **6**, the central module **15***a* is depicted. A receive pair of conductors from the hub **1** pass through connector **67** (FIG. **6**) and connect to blocking circuit

20, test voltage source 64, and test voltage monitor 66. A +15 volt source with series resistor 65 comprises test voltage source 64. A comparator 68 with a resistor divider circuit comprises the test voltage monitor 66. Diode 70 connects from the divider circuit to the power input of comparator 68 to suppress voltage transients at the input to comparator 68. A low power TLC2274ACD is employed for comparator 68 of the present embodiment. The test voltage source 64 and test voltage monitor 66 pair monitor the receive conductors to ensure the hub 1 is connected to central module 15. Blocking circuit 20 includes high pass filter 60, relay 61, and high pass filter 62 which connects to a receive pair of conductors from the remote module 16. High pass filter 62 also connects internally to signal receiver 6. High pass filters 60 and 62 block DC current flow and isolate the relay 61 from driver circuits of hub 1 and PC 3A to enable the central module 15*a* to continue to monitor the conductors from the remote module 16*a*. Signal receiver 6 comprises an isolation transformer 72, low pass active filter 74, and comparator 76. The output of comparator 76 is decoded by Manchester decoder 5 and then sent to firmware kernel 4. A processor 77 is employed to implement the kernel 4 and status data encoder 9 functions. The processor 77 in the illustrated embodiment is a Microchip PIC16C62. Internal to the processor 77 data received from internal and external signals is encoded and then outputted to signal modulator 7 which comprises NPN transistor 78 and PNP transistor 80 arranged in a level shifter configuration. The output of signal modulator 7 is diode OR'd with the output of isolation power supply 8 and then connects to one of the transmit data lines that connect to remote module 16. The return path for current from PC 3A is the pair of receive data lines. Test voltage monitor 84 operates in a manner similar to test voltage monitor 66 to ensure PC 3A is physically attached to the network 17. Firmware kernel 4 controls the operation of blocking circuit 88 which is connected across the transmit data lines that connect to hub 1. High pass filter 86 blocks DC current from flowing to hub 1 from signal modulator 7 and additionally provides isolation between blocking circuit 88 and the drivers of PC 3A. Connector 90 provides the interface for signals from central module 15*a* to the cable that interfaces with remote module 16*a*.

Referring to FIGS. 7 and 8, the remote module 16*a* of the second embodiment is illustrated. The receive data lines from central module 15*a* pass through connector 101 (FIG. 8) and connect to high pass filter 100 and signal transmitter 12. High pass filter 100 blocks the DC current that flows from central module 15*a* from flowing into the input circuit of PC 3A. Signal transmitter 12*a*, which comprises resistors 104 through 109 and bypass capacitor 110, impresses across the receive data lines a variable current source that is controlled by firmware kernel 10. Connected to a transmit line is isolation power supply 13 which receives power from central module 15*a*. The isolation power supply 13 comprises resistor 112, filter capacitor 113, and zener diode 114. The regulated voltage developed across zener diode 114 provides power for firmware kernel 10 as well as a number of pull-up resistors. Although a Microchip PIC12C508 processor is employed for firmware kernel 10 in the illustrated embodiment, there are numerous other devices from manufacturers such as SGS Thompson and Burr-Brown that may be employed. The outputs from remote module 16*a* pass through connector 116 which connects to PC 3A.

Referring to FIGS. 4 and 5, the operation of the second embodiment will be described. The existence of a connection between hub 1 and central module 15*a* is monitored by test voltage source 64 and test voltage monitor 66 through a pair of receive data lines. Current from test voltage source 64 flows through a data line to an isolation transformer within hub 1. The current flows through the primary winding of the isolation transformer and returns on the other receive data line to the test voltage monitor 66. An interruption in the flow of current is detected by the test voltage monitor 66. A detailed description of the operation of test voltage source 64 and test voltage monitor 66 is provided in U.S. Pat. No. 5,406,206 which is hereby incorporated by reference. Similarly, current sourced onto a transmit line from signal modulator 7 and isolation power supply 8 through remote module 16*a* to the isolation transformer of PC 3A which returns on the other transmit line is monitored by test voltage monitor 84 to verify that both remote module 16*a* and PC 3A are connected to central module 15*a*. Signal modulator 7 additionally supplies power to remote module 16*a*. A signal from firmware kernel 4 controls NPN transistor 78 which likewise controls level-shifting PNP transistor 80. When PNP transistor 80 is ON, 20 volts is sourced onto the transmit line. When transistor 80 is OFF, 15 volts is sourced onto the transmit line. Referring to FIG. 8, the sourced power from central module 15*a* flows through resistor 112 and into zener diode 114 and capacitor 113 which provide a regulated voltage to the circuit. In this embodiment the status data transmitted from the central module 15*a* is not decoded. However, it is within the scope of the invention to receive the encoded data by monitoring various signals, such as the voltage amplitude of the data line relative to ground, the voltage across resistor 112, and the current through resistor 112.

In response to external signals as well as internally programmed routines, the firmware kernel 10 outputs a signal to Manchester encoder 11. A processor 102 incorporates both the kernel 10 and Manchester encoder 11 functions. In the illustrated embodiment a Motorola PIC12C508 is employed as processor 102. The output of the processor 102 is a Manchester encoded signal that drives the balanced resistor network that comprises signal transmitter 12*a*. A capacitor 110 and resistors 106 and 107 can be added to signal transmitter 12*a* to provide increased filtering of high frequency components. However, the embodiment does not require their addition as firmware control and line capacitance provide sufficient attenuation to prevent the encoded signal from interfering with normal network communications. The encoded signal flows through resistors 104 and 105 onto the receive data lines to central module 16. High pass filter 100 prevents the encoded signal from being conducted through the receive data lines to PC 3A. Although the encoded signal in the present embodiment transmits the encoded signal from the remote module 16*a*, it is within the scope of the invention to source current from the central module and alter the flow of current from within the remote module 16*a* by changing the impedance of a circuit connected across the data communication link 2A. Examples of such circuits include an RC network connected directly to the data link 2A and reflecting an impedance change across an isolation transformer.

Referring again to FIG. 6, the encoded signal is received in the central module 15*a* by signal receiver 6. Within central module 15*a*, high pass filter 62 prevents the encoded signal from being conducted through the data lines to hub 1. The signal couples through transformer 72 to low pass active filter 74 which filters out normal network communications signals. The filtered signal is squared-up by comparator 76 and outputted to Manchester decoder 5. The decoded signal is inputted to firmware kernel 4 which evaluates the information. If the signal represents the port ID or wall jack location, the kernel 4 outputs a signal to external device 19. If the signal provides identification of remote module 16, the kernel 4 compares the received identification with the expected iden-

tification. If an invalid identification is received, the firmware kernel **4** sends signals to blocking circuits **20** and **88** commanding them to short the receive data lines together and the transmit data lines together. The kernel **4** additionally sends an alarm notifying external device **19** that an invalid identification has been received. Although the embodiment passes a single signal through the decoder circuit, it is within the scope of the invention to feed encoded signals from multiple sources through a multiplexer into a single decoder circuit, or to implement the decode function in firmware or software, or to multiplex the outputs of multiple decoder circuits. It is also within the scope of the invention to couple the signal from the receiver data lines through an isolating device into a microprocessor wherein the low pass filtering and decoding functions are implemented. Envisioned isolating devices include devices such as transformers, opto-isolators, and balanced operational amplifier circuits. Additionally, it is within the scope of the invention to integrate all the functions of the remote module into a processor that interfaces either directly to the data lines or through an isolating device.

A third embodiment of the invention is illustrated in FIG. **10** which generally differs from the earlier described embodiments by illustrating in detail a circuit as described in the first embodiment wherein current that is sourced through a current loop extending from central module **15***b* to remote module **16***b* is modulated in remote module **16***b* and then decoded in central module **15***b*. The embodiment comprises a central module **15***b* and remote module **16***b* that are connected within an existing network **17***b*. The central module **15***b* comprises a test voltage source **117** and a receiver circuit **119**. The test voltage source **117** includes a +15 volt source with series resistor **118** for sourcing current onto a transmit data line. The receiver circuit **119** comprises a signal receiver **6**, a Manchester decoder **5**, and firmware kernel **4***b*, for receiving and decoding the return current from the receive data lines.

Remote module **16***b* includes an isolation power supply **13** that regulates and filters power that is received from central module **15***b* over a pre-existing cable. The isolation power supply **13** supplies regulated power to a processor **122** and circuitry that comprises the signal transmitter **12***b*. The processor **122** employed in the illustrated embodiment is a Microchip PIC12C508. The processor **122** and exclusive OR gates **120** and **121** implement both the firmware kernel **10** and Manchester decoder **11** functions. An isolation transformer **124**, bypass capacitor **110**, and resistors **126-129** comprise the signal transmitter **12***b* which modulates the current from isolation power supply **13** that returns to central module **15***b*. Capacitors **130** and **132** comprise a high pass filter that blocks the transmitted signal from interfering with normal network communications.

Continuing to refer to FIG. **10**, the operation of the third embodiment will be described. Within central module **15***b*, power flows from the +15 volt source through series resistor **118** and a transmit data line, to the isolation power supply **13** in remote module **16***b*. Within remote module **16***b*, power from the transmit data line is regulated by zener diode **114** and filter capacitor **113**. The current which flows through resistor **112** splits, with a portion flowing through processor **122** and the exclusive OR gates, and the remainder flowing through zener diode **114**. The return current flowing out of zener diode **114** and the circuit ICs, flows into the secondary winding center-tap of isolation transformer **124**. The current splits between the windings with the reflected primary impedance controlling the magnitude of the current that flows in each winding. The primary impedance is controlled by processor **122**, the exclusive OR gates **120** and **121**, and the two 10 k resistors **126** and **127**. A high logic level output from exclusive OR **120** results in current flowing through resistor **126**, the primary of isolation transformer **124**, resistor **127**, and into exclusive OR **121**. The current flowing through the transformer primary is reflected to the secondary where it adds with current flowing through one winding and subtracts from current flowing through the other winding. The direction of the current flowing through the primary changes as the output of exclusive OR **120** alternates between a logic level high and low in response to the Manchester encoded stream from processor **122**. The variation in primary current flow direction added to the secondary current flowing into the center-tap results in a modulated current signal. The high frequency components of the resulting secondary winding current flow through bypass capacitor **110**. The low frequency components flow through resistors **128** and **129**, onto the receive data lines, to the central module **15***b*, and through isolation transformer **72** to signal ground. Resistors **128** and **129** provide a buffer to prevent the bypass capacitor **110** from loading down the data lines.

Within central module **15***b*, the modulated current is reflected from the primary to the secondary of isolation transformer **72**. Low pass active filter **74** filters out high frequency network communication components and passes a squared-up output to the Manchester decoder **5**. The decoded data stream is inputted to the firmware kernel **4** which evaluates the data stream to ensure a valid identification number was transmitted.

Referring to FIG. **18**, a presently preferred embodiment, the fourth embodiment, of the invention is illustrated. The fourth embodiment differs from the earlier described embodiments by employing an interface amplifier for the signal receiver **6***c* in place of an isolation transformer, adding a third source voltage to central module **15***c*, adding a NIC Stick **170**, reconfiguring the signal transmitter of the remote module **16***c*, and adding an electronic tether **150**. The signal receiver interface amplifier is configured as a bandpass filter using design techniques that are well known in the art. The output of the interface amplifier is connected to the processor **77** wherein the signal is decoded. The NIC Stick **170** provides an improved method of interconnecting the signals that flow between the various modules of the preferred embodiment. The NIC Stick **170** and remote module **16***c* are integrated into a connector assembly for interconnect to a PC. The purpose and function of the tether **150** is provided in a subsequent section of this specification.

Turning now to FIGS. **11-13** the remote module **16** is illustrated as being contained in a special box-like housing **23**. The electronics are mounted on a suitable card **22** within the confines of a container **24**. The container **24** is mounted to the computer **3**A using the existing fasteners normally found on the back of the computer. Such a fastener is illustrated at **26**. The fastener **26** is chosen to be one that is required to be removed in order to gain access to the hardware inside the computer. Therefore, the potential thief must remove fastener **26** to steal the mother board, network identification card (NIC), etc. Lid **32** likewise contains opening **34**. When the lid is closed as shown in FIG. **13**, the opening **28** is aligned with opening **34**. These openings allow the normal network wire connector **38** to pass through the openings in housing **23** and engage the electronics card **22**. Housing **23** includes an output cord **40** with a connector **42** which engages the standard network interface card (NIC) found in the computer. This construction is designed to require the potential thief to disconnect connector **38** from housing **23** in order to gain access to the fastener **26** which must be unscrewed in order to remove the internal computer parts. When the connector **38** is removed, the computer **3**A becomes, likewise, disconnected

from the network. This causes the current in loop **2**A to drop below a threshold level which causes the system **15** to cause a system alarm or the like to be activated. Thus this housing configuration deters theft of the internal parts of the computer since fastener **26** must be removed to gain access to them, as well as deterring removal of the entire computer terminal.

FIGS. **14-15** show an alternative embodiment in which the electronics for network identification circuitry **16** are instead placed upon a card **44** which can be inserted into an adjacent slot in the computer next to the standard NIC card **46**. The network wire connector **38** is connected to the input of card **44** and the output of identification card **44** is then connected to the normal input receptacle **48** of NIC card **46**. It is also envisioned that the electronics of the network identification circuitry can be placed on a motherboard within the computer or as part of the circuitry on the NIC card.

FIG. **16** shows a schematic of another implementation in which the electronic tether **150** extending from the remote module **16** is attached to equipment to be protected. The remote module **16** monitors the status of the tether **150** and notifies the central module **15** if the tether **150** is removed or the electrical connection interrupted. The central module then sets a system alarm either centrally or locally. The tether **150** includes two conductive lines **152** and **154** coupled between a pair of connectors **156** and **158**. An attachment status signal is conducted through the conductive lines **152** and **154** for indicating whether the tether **150** remains attached to the protected equipment. The first conductive line **152** includes pads P**1** and P**2** inline to provide a means of shorting a break in the line. The second conductive line **154** is coupled directly between the connectors. An external jumper **160** is connected to the output connector **158** of the tether **150** to complete the electrical connection.

FIG. **17** illustrates the electronic tether **150** mounted to the surface of equipment to be protected. A conductive pad **162** having conductive adhesive on both sides is bonded to the equipment surface. The adhesive on the side facing the equipment has greater strength than the adhesive on the side facing the tether. The relative strength of the adhesive on either side of the conductive pad **162** is chosen to ensure that if the tether **150** is removed the conductive pad **162** will remain bonded to the equipment, not to the tether. The tether **150** is bonded to the conductive pad **162** so that the pads, P**1** and P**2**, make electrical contact with the conductive pad **162**.

In operation, the tether **150** is bonded to a piece of equipment to be protected such as monitors, printers, fax machines, and chairs. Multiple tethers can be connected in series to provide protection for more than one piece of equipment. The remote module **16** monitors the status of the attachment status signal from the tether **150** to determine that an electrical short is maintained. An interrupted attachment status signal indicates that either a tether **150** is no longer connected to its associated piece of equipment or the electrical connection to the tether **150** has been interrupted. Upon detecting an interrupted attachment status signal, the remote module **16** sets a bit of the identification number that is transmitted to the central module **15**. The central module **15** then sets an alarm either locally or centrally.

From the foregoing it will be understood that the invention provides a system for communicating with electronic equipment on a network. The system transmits a signal over preexisting network wiring or cables without disturbing network communications by coupling a signal that does not have substantial frequency components within the frequency band of network communications. The system is particularly suitable for high-frequency networks such as Ethernet operating at speeds of 10 megabits per second (Mb/s) and higher. For purposes of this invention the term "high frequency information" means the band of frequencies needed to carry data at 10 Mb/s or more. Coupling a lower frequency signal to the data lines of such a network permits increased utilization of the available transmitting medium without a commensurate increase in the cost of the network. To ensure that the added lower frequency signal does not interfere with normal network communications the added signal must not contain frequency components that interfere with the network signals. For example, when the invention is used with an Ethernet 10BASE-T network, the specifications for that network method place stringent restrictions on the behavior of the medium for frequencies from 5 MHz to 10 MHz with some parameters specified to frequencies as low as 1 MHz. In the present embodiment a simple highpass circuit at 150 kHz formed by adding capacitors into each wire of the medium is employed to isolate the injected signal from normal network communications, resulting in substantially no disruption of the high frequency network information. Additionally, employing a higher order high pass filter would permit operation with less disruption than a lower order high pass filter at the same corner frequency. For the purposes of the invention, the term "low frequency signal" means signals in which the energy representing the data can be reliably carried in the band of frequencies made available by this filtering. Typically, this means that the low frequency signals operate at a bit rate which is less than about 1% of the bit rate of the high frequency signals which carry the network communication data. By way of a specific example, the high frequency information in the embodiment of FIGS. **4-8** operates in the range of about 10 Mb/s while the encoded signal sent from remote module **16***a* to central module **15***a* operates in the range of about 1200 bits per second. Although the present embodiment operates in the range of about 1200 bits per second, it is within the scope of the invention to operate at bit rates up to 57.6 kb/s by increasing the filter frequencies, operating in a lower noise environment, or increasing the degradation of network communications. Further suppression of harmonics results from the lowpass filtering provided by the resistors used to couple the low frequency signal to the data lines acting with the capacitors used for the highpass function mentioned above.

Additionally, the system provides a means for permanently identifying the location of network assets without applying power to the assets. Also, the system can be employed to determine asset inventory, i.e. when an asset is being removed or added to the network. The system permits a company to track its assets, locate any given asset, and count the total number of identified assets at any given time. In addition, the system provides a means of blocking communications with an unauthorized device that is connected to the network. Furthermore, the system allows the automatic blocking of communications with an unauthorized device. Additionally, the system is particularly suitable to be integrated into an asset aware patchpanel in order to provide a means for identifying the location of network assets.

Referring to FIGS. **21** and **22**, a system **200** for communicating with equipment is illustrated. The system provides a means of assigning a permanent electronic identification number to an object. The object electronic number is used to monitor the configuration of the object, to control access to network entities such as programs and servers, and to provide network management information. The initial configuration of a network device is stored and referenced in a network database by the object identification number, permitting subsequent comparisons between the initial configuration and the subsequent configuration of the network device. Another permanent electronic number may be assigned to the physical

location of the object. The location electronic number combined with the object electronic number provides simultaneous references for location and configuration of an object. The network database further includes the location associated with the location identification number, thereby permitting between the initial location and configuration, and the subsequent location and configuration of an object. The system **200** includes an ID sender tag **202** that has a unique identification number and is physically attached to an object **204**. In the preferred embodiment the identification number is programmed at manufacture and is not changeable. Once the ID sender tag **202** is attached to an object, the identification number becomes associated with that object **204**. In the presently preferred embodiment of the invention, a first sender tag **202** is attached to a computer **204***a* and a second sender tag **202** is attached to a wall **204***d* near the computer **204***a*. However, other objects are within the scope of the invention, such as desks **204***b*, monitors **204***c*, computer pointing devices, other computers (powered and unpowered), and clothing. The first sender tag **202** provides identification information and the second sender tag **202** provides location information. Each sender tag **202** transmits a serial stream that includes a unique identification number corresponding respectively to the computer **204***a* and the wall **204***d*. A decoder plug **206** attached to a computer port is electronically coupled to the sender tag **202**. The decoder plug **206** receives the serial stream, and then converts the serial stream into a signal format that is compatible with the port to which the decoder plug **206** is connected. Although, in the presently preferred embodiment the decoder plug **206** is connected to a computer parallel port **210**, the principles of the invention may be readily extended to other types of ports, such as USB, Firewire, keyboard, and serial ports. In addition, the scope of the invention includes coupling multiple ID senders **202** to a single decoder plug **206** so that multiple objects can be monitored with the decoder plug **206**. Also, connecting multiple decoder plugs **206** in series is within the scope of the invention. The decoder plug **206** includes an identification number, thereby permitting the interconnected decoder plugs **206** and ID sender tags **202** to be logically linked together. The parallel port **210** is included within the computer **204***a*, which is connected to a network **212**. Referring to FIG. **19***a*, a port reader **218** in the computer **204***a* reads the converted serial stream at the parallel port **210** and sends the communicated information over the network **212**. The scope of the invention includes employing pre-existing collector software as an interface to the port reader for communicating with the decoder plug **206**. A server **214** connected to the network **212**, includes a control manager **216** that receives and analyzes the communicated information. The control manager **216** includes a database for storing communicated information such as initial and subsequent locations and configurations for identified objects. Although the presently preferred embodiment of the invention includes a port reader **218** and a control manager **216**, the principles of the invention may be practiced with merely an ID sender tag **202** electronically coupled to a decoder plug **206**.

Referring to FIG. **19***b* in addition to FIG. **19***a*, the mounting configuration of the sender tag **202** is illustrated. A mounting arrangement similar to that of the electronic tether **150** described in an earlier section of this specification is employed to mount the sender tag **202** to the surface of an object. The sender tag **202** includes pads **205** for mounting. A conductive pad **203** having conductive adhesive on both sides is bonded to the pads **205** for attaching the sender tag **202** to an equipment surface. The adhesive on the side facing the equipment has greater strength than the adhesive on the side facing the pads **205**. The relative strength of the adhesive on either side of the conductive pad **203** is chosen to ensure that if the sender tag **202** is removed the conductive pad **203** will remain bonded to the equipment, not to the pads **205** of the sender tag **202**. With the conductive pad **203** attached to the sender tag **202** an electrical connection is established between the pads **205**.

Referring to FIG. **20** in addition to FIG. **19***a*, the ID sender tag **202** of the presently preferred embodiment is illustrated. The ID sender tag **202** is a physical identifier that has an identification number that is programmed at manufacture. The identification number is remotely readable through a communication interface that is continuously operable and parasitically powered. The ID sender tag **202** includes a processor **220** for Manchester encoding and sending the identification number over the attached serial bus. Although, Manchester encoding is employed in the preferred embodiment, other forms of transmitting a serial stream are within the scope of the invention, such as single bit on/off, 4B/5B, Frequency Shift Keying (FSK), and techniques that result in a DC bias on the line. Regulating and filtering the power for the processor **220** is provided by circuitry that is configured using design techniques that are well known in the art. Additionally, a set of resistors is selected using design techniques that are well known in the art to buffer the output of the processor **220** from the serial bus. The firmware of processor **220** is programmed to provide an ID manager **222** function. The ID manager **222** generates an identification packet using procedures for Manchester encoding and RS232 framing of a unique identification number. Table 1 includes pseudocode of the procedures carried out by the ID manager **222**.

TABLE I

Pseudocode for ID Manager
Retrieve the data words containing the identification number.
Load the data words containing the identification number into RAM.
Begin Encode Loop
Begin transmitting information.
Set the start bit to begin the first half of the Manchester cycle.
Load a data word
Pad out time and set the end bit.
Set the start bit to begin the second half of the Manchester cycle.
Load a data word.
Pad out time and set the end bit.
Set RS-232 framing
Loop until the packet is complete

Referring to FIG. **20** in addition to FIG. **19***a*, the decoder plug **206** of the presently preferred embodiment is illustrated. The decoder plug **206** is a physical reader that has an identification number that is programmed at manufacture. The continuously operable and parasitically powered communication interface permits the decoder plug **206** to remotely read the identification number of an attached ID sender **202**. The decoder plug **206** includes a signal receiver **230**, a processor **232**, and a voltage regulator **234**. The signal receiver **230** provides a balanced impedance on the serial bus for receiving the serial stream from the sender tag **202**. The buffered serial stream is coupled from the output of the signal receiver **230** to an input of the processor **232** which converts it into a parallel stream. Firmware in the processor **232** implements an ID reader module **236** to provide the conversion function. A tri-state buffer **233** coupled to the processor **232** permits unobstructed passthrough communication from the interface port **210** to a peripheral device coupled to the decoder plug **204** through a connector **235**. Power, Vcc, from the parallel port is regulated by the voltage regulator **234** and used to

power the processor **232** and signal receiver **230**. Table II provides pseudocode of the ID reader module **236**.

TABLE II

Pseudocode for ID Reader Manager
Load the Manchester encoded data.
Perform a majority sample decode (converts the Manchester symbols to a bit stream)
Strip the start and end bits.
Output a series of bytes.
Assemble the bytes into a message.
Perform error and checksum testing.
Store the message.

In operation, the communication system has multiple operating modes, such as asset control mode, network management information mode, and license control mode. In asset control mode the system provides external identifiers as a guaranteed reference for computer change control including change of location and change of configuration. During network management information mode the system automates the physical management and inventory of equipment. In license control mode the system trades access to the computer in exchange for a physical inventory of the connected identifiers.

With reference to FIGS. **19***a* and **20**, during asset control mode the control manager **216** located in the server **214** sends an asset identifier request to the port reader **218** requesting the identification number of equipment that is monitored by the computer **204***a*. The asset identifier request is passed through the decoder plug **206** to each of the ID sender tags **202** that are associated with the computer **204***a*. The ID manager **222** in each ID sender tag **202** Manchester encodes a predefined identification number and transmits the encoded number to the decoder plug **206** as a serial stream with RS-232 framing. The ID reader module **236** in the decoder plug **206** performs a majority sample decode to convert the Manchester symbols to a bit stream. In addition, the reader module **236** provides the equivalent of a UART by stripping the start and end bits and outputting a series of bytes. The bytes are then assembled into an ID sender message and stored after appropriate error and checksum testing. The decoder plug **206** then formats the stored sender messages for transmission to the interface port **210**. First, a decoder message is assembled, consisting of identification information related to the decoder plug **206**, status information, and the stored sender messages. Second, a MAC/physical layer which handles the interface and handshaking to the interface port **210** is constructed. The decoder plug **206**, then transmits the assembled decoder information to the interface port **210**. The port reader **218** receives the assembled decoder information, reformats the enclosed messages and transmits the reformatted messages to the control manager **216**. The control manager **216** evaluates the response from the computer **204***a*. The evaluation by the control manager **216** includes comparing and updating the configuration and location information of the queried objects with previously stored information in the associated database. The initial physical identity and initial physical location of an object is input to the database during setup of an ID sender tag **202** by an operator such as a user. Information related to the object is also inputted to the database. Related object information includes the object serial number, physical attributes, physical configuration, electronic attributes, software configuration, network attributes, and date of entry.

Continuing to refer to FIGS. **19***a* and **20**, during network management information mode a network manager determines the location or configuration of assets that are coupled to the network by interrogating ID senders **202** and decoder plugs **206** attached to assets. The system is especially useful for token ring and fiber optic networks since the location information related to an object is provided by an ID sender tag **202** attached to a relatively immobile surface rather than reading a port address associated with a network device. The method of interrogating the ID sender tags **202** is similar to that employed during asset control mode except asset configuration information is requested instead of merely identification of attached objects.

During license control mode a key manager located in server **214** limits access to selected programs to predetermined assets or a quantity of assets rather than to predetermined users or a quantity of users. In response to a user attempting to open a controlled program, the key manager ascertains the asset the user is employing and the identification number assigned to the asset in a similar manner to that described for asset control mode. The key manager then employs access criteria to determine whether to grant access to the controlled program.

Although, in the preferred embodiment the comparison function of the control manager and database is executed on a network server electronically coupled through a network to an ID sender tag **202**, the scope of the invention includes conducting the comparison locally on a computer that is being scanned, in a central database over a network, over a corporate intranet, and over the world wide Internet.

In operation, an application which runs "Java" through a standard browser is provided. A requestor connected to the Internet selects a button to request related object information from an Internet connected object. In response to the request, an ActiveX (Java) control gets pulled down onto a computer connected to the object, runs and reads the object identification number and the object location identification number from ID sender tags **202**. The computer reports the related object information back to the requester over the Internet.

From the foregoing it will be understood that the invention provides a system and method for remotely detecting and reading an asset identity and location. Additionally, the system and method can be employed to automate collection and validation of asset identity and location. The system and method provide a means for communicating with an asset based on identity or location. In addition, the system and method permit the automated comparison and storage of asset configuration and location information. Also, the system and method can be employed to automate asset change control. Additionally, the system and method provide a means to perform asset management, remote identification, and remote access security over the Internet in a guaranteed fashion.

The attachment of a remote module **16** or an ID sender tag **202** to an object provides an identification number corresponding to the object. The location of an object with an attached remote module **16** is provided by the corresponding port address associated with the object. The location of an object with an attached ID sender tag **202** is provided by an associated ID sender tag **202** that is attached to a surface of a wall, floor, or other relatively immobile object.

It should be understood that while this invention has been described in connection with particular examples thereof, no limitation is intended thereby since obvious modifications will become apparent to those skilled in the art after having the benefit of studying the foregoing specification, drawings and following claims.

What is claimed is:

1. A system for communicating information on a network having pieces of electronic equipment that connect to the network by cables having a plurality of wires therein, said system comprising:

a central module having at least one power source;

a first piece of equipment;

a first cable having wires therein connected between the central module and the first piece of equipment;

a first remote module utilized in conjunction with the central module to alter a flow of current within at least a pair of wires in the first cable, the altered current flow communicating information about the first piece of equipment to the central module while the first piece of equipment is physically connected to the network via the first cable;

a second piece of equipment;

a second cable having wires therein connected between the central module and the second piece of equipment; and

a second remote module utilized in conjunction with the central module to alter a flow of current within at least a pair of wires in the second cable, the altered current flow communicating information about the second piece of equipment to the central module while the second piece of equipment is physically connected to the network via the second cable.

2. The system of claim 1 wherein the information wires in the cable that normally carry high frequency data communications over the network to a piece of electronic equipment.

3. The system of claim 1 wherein the information is a unique signal related to the piece of equipment to which each remote module is associated.

4. The system of claim 3 wherein said central module further comprises:

a monitor for decoding the unique signal communicated over the cable thereby identifying the equipment associated therewith.

5. The system of claim 1 wherein a remote module is a device attached to a piece of equipment.

6. The system of claim 1 wherein the central module identifies the existence and location of a piece of equipment even if the piece of equipment is powered off.

7. The system of claim 1 wherein the central module further comprises a power modulator for modulating power from the power source and coupling a modulated power signal over the cables to the remote modules, and

wherein the remote module further comprises a power demodulator for demodulating the modulated power signal to detect information sent from the central module;

whereby the remote modules can operate on power from the central module without the electronic equipment being powered, and further that information can be bi-directionally transmitted between the central module and remote modules.

8. The system of claim 1 wherein the central module detects the absence of a proper signal associated with a piece of equipment on the network and blocks network services from being delivered to that piece of equipment.

9. The system of claim 1 which further comprises:

a database having information that identifies each piece of equipment and its location on the network, along with an identification signal for each piece of equipment; and

wherein the system periodically updates the database as a function of the communicated information to thereby track the identity and location of the equipment on the network.

10. The system of claim 1 wherein the central module is used to limit access to selected programs as a function of the information communicated by at least one remote module.

11. The system of claim 2 wherein the information is in the form of multi-bit information and wherein the bit rate of the multi-bit information is less than about 1% of the bit-rates of the high frequency data communications.

12. The system of claim 1 wherein the information can be communicated to the central module even if a piece of electronic equipment is powered off.

13. The system of claim 1 wherein the network is an Ethernet network.

14. The system of claim 11 wherein the frequency of the high frequency data is at least 10 Mbits/sec and the bit rate of the multi-bit information is not more than 100 kb/sec.

15. The system of claim 1 wherein the cables are twisted pair Ethernet cables.

16. A system for communicating information on a network, said system comprising:

a central module having at least one power source;

a first piece of equipment;

a first cable having a plurality of wires therein, at least a pair of wires in said first cable connecting the first piece of equipment to the central module through a first loop;

a first remote module connected to the first piece of equipment;

said first remote module including a transmitter utilized in transmitting first low-frequency multi-bit information to the central module over wires in the first cable without disturbing normal network high frequency data communication carried by wires in the first cable, said first remote module being utilized in conjunction with the central module to generate said first multi-bit information by altering a flow of current in the first loop while the first piece of equipment is physically connected to the network via the first cable;

a second piece of equipment;

a second remote module connected to the second piece of equipment;

a second cable having a plurality of wires therein, at least a pair of wires in said second cable connecting the second piece of equipment to the central module through a second loop; said second remote module including a second transmitter utilized in transmitting second low-frequency multi-bit information to the central module over at least a pair of wires in the second cable without disturbing normal network high frequency data communication carried by wires in the second cable, said second remote module being utilized in conjunction with the central module to generate said second multi-bit information by altering a flow of current in the second loop while the second piece of equipment is physically connected to the network via the second cable; and

wherein said central module detects the multi-bit information transmitted over the first and second cables from the first and second pieces of equipment on the network.

17. The system of claim 16 wherein:

the first transmitter is electrically coupled to the first loop and is utilized in modulating an electrical characteristic of the first loop to define the first low frequency multi-bit information associated with the first piece of equipment; and

the second transmitter is electrically coupled to the second loop and is utilized in modulating an electrical characteristic of the second loop to define the second low frequency multi-bit information associated with the second piece of equipment.

18. The system of claim 16 wherein the cables are twisted pair Ethernet cables.

19. The system of claim 1 wherein the altered current flow includes two or more changes in the current flow.

20. The system of claim 1 wherein the current flow is a DC current flow and the altered current flow includes at least one change in the magnitude of the DC current flow.

21. The system of claim 1 wherein a remote module includes a transmitter and the central module includes a receiver.

22. The system of claim 1 wherein the current flows through a center-tap of at least one isolation transformer.

23. The system of claim 1 wherein a remote module is integrated into a piece of equipment.

24. The system of claim 23 wherein a remote module consists of one or more electrical components.

25. The system of claim 1 wherein the central module is integrated into centralized network equipment.

26. The system of claim 25 wherein the centralized network equipment is a hub.

27. The system of claim 25 wherein the centralized network equipment is a patch panel.

28. The system of claim 1 wherein the central module includes a second power source.

29. The system of claim 1 wherein the information is utilized to selectively provide one or more electrical signals to one or more pieces of equipment.

30. The system of claim 29 wherein at least one electrical signal is a DC current signal.

31. The system of claim 1 wherein the wires within which the current flow is altered are the same wires used for normal network communication.

32. The system of claim 1 wherein the number of wires within which the current flow is altered is four.

33. The system of claim 1 wherein the information uniquely distinguishes a piece of equipment.

34. The system of claim 1 wherein the information identifies an electronic attribute of a piece of equipment.

35. The system of claim 1 wherein the information identifies a network attribute of a piece of equipment.

36. The system of claim 1 wherein the information identifies a physical attribute of a piece of equipment.

37. The system of claim 1 wherein the information identifies a physical configuration within a piece of equipment.

38. The system of claim 1 wherein the information is utilized to distinguish between different pieces of equipment.

39. The system of claim 1 wherein the information identifies a software configuration of a piece of equipment.

40. The system of claim 1 wherein the information identifies the port location of a piece of equipment.

41. The system of claim 1 wherein the information is utilized by a control circuit.

42. The system of claim 1 wherein the information is utilized to provide a notification signal.

43. The system of claim 1 wherein the central module interrogates a piece of equipment connected to the network.

44. The system of claim 43 wherein the central module selectively controls network services to the equipment based upon the interrogation.

45. The system of claim 1 wherein the altered current flow results from at least one change in voltage across the wires.

46. The system of claim 1 wherein the altered current flow results from at least one change in impedance across the wires.

47. The system of claim 1 wherein the wires within which the current flow is altered form a current loop through a piece of equipment and the flow of current through the current loop indicates a physical connection of the equipment to the network.

48. The system of claim 1 wherein the information can be communicated even if a piece of equipment is powered off.

49. The system according to claims 1, 19-46 or 47 wherein the network includes an Ethernet network and the cables are twisted pair Ethernet cables.

50. The system according to claims 1, 19-46 or 47 wherein a piece of equipment is Ethernet equipment and normal network communication is BASE-T Ethernet.

51. The system of claim 49 wherein the information can be communicated even if a piece of equipment is powered off.

52. The system of claim 50 wherein the information can be communicated even if a piece of equipment is powered off.

53. A system for conveying information on a network having objects that connect to the network by cables having a plurality of conductors therein, said system comprising:

a central module having at least one power source;

a separate cable connected between each object and the central module, each cable having a plurality of conductors therein;

a remote module utilized in conjunction with the central module to alter a flow of current within at least two of the conductors in the cable, the altered current flow conveying information about an object to the central module while the object is physically connected to the network via the cable.

54. The system of claim 53 wherein a remote module is a device attached to the object.

55. The system of claim 53 wherein the altered current flow includes two or more changes in the current flow.

56. The system of claim 53 wherein the current flow is a DC current flow and the altered current flow includes at least one change in the magnitude of the DC current flow.

57. The system of claim 53 wherein a remote module includes a transmitter and the central module includes a receiver.

58. The system of claim 53 wherein the current flows through a center-tap of at least one isolation transformer.

59. The system of claim 53 wherein a remote module is integrated into the object.

60. The system of claim 59 wherein a remote module consists of one or more electrical components.

61. The system of claim 53 wherein the central module is integrated into centralized network equipment.

62. The system of claim 61 wherein the centralized network equipment is a hub.

63. The system of claim 61 wherein the centralized network equipment is a patch panel.

64. The system of claim 53 wherein the central module includes a second power source.

65. The system of claim 53 wherein the information is utilized to selectively provide one or more electrical signals to one or more objects.

66. The system of claim 65 wherein at least one electrical signal is a DC current signal.

67. The system of claim 53 wherein the conductors within which the current flow is altered are the same conductors used for normal network communication.

68. The system of claim 53 wherein the number of conductors within which the current flow is altered is four.

69. The system of claim 53 wherein the information uniquely distinguishes the object.

70. The system of claim 53 wherein the information identifies an electronic attribute of the object.

71. The system of claim 53 wherein the information identifies a network attribute of the object.

72. The system of claim 53 wherein the information identifies a physical attribute of the object.

73. The system of claim 53 wherein the information identifies a physical configuration within the object.

74. The system of claim 53 wherein the information is utilized to distinguish between different objects.

75. The system of claim 53 wherein the information identifies a software configuration of the object.

76. The system of claim 53 wherein the information identifies the port location of an object.

77. The system of claim 53 wherein the information is utilized by a control circuit.

78. The system of claim 53 wherein the information is utilized to provide a notification signal.

79. The system of claim 53 wherein the central module interrogates an object connected to the network.

80. The system of claim 79 wherein the central module selectively controls network services to the object based upon the interrogation.

81. The system of claim 53 wherein the altered current flow results from at least one change in voltage across the conductors.

82. The system of claim 53 wherein the altered current flow results from at least one change in impedance across the conductors.

83. The system of claim 53 wherein the conductors within which the current flow is altered form a current loop through the object and the flow of current through the current loop indicates a physical connection of the object to the network.

84. The system of claim 53 wherein the information can be conveyed even if the object is powered off.

85. The system according to claims 53-82 or 83 wherein the network includes an Ethernet network and the cables are twisted pair Ethernet cables.

86. The system according to claims 53-82 or 83 wherein the object is a piece of Ethernet equipment and normal network communication is BASE-T Ethernet.

87. The system of claim 85 wherein the information can be conveyed even if the object is powered off.

88. The system of claim 86 wherein the information can be conveyed even if the object is powered off.

89. A method for conveying information on a network having objects that connect to the network by cables having a plurality of conductors therein, said method comprising:

connecting a separate cable between each object and a central module, each cable having a plurality of conductors therein;

selecting a number of the conductors within a cable;

applying at least one power source to the selected conductors;

utilizing a remote module in conjunction with the central module to alter a flow of current within the selected conductors in the cable, the altered current flow conveying information about an object to the central module while the object is physically connected to the network via the cable.

90. The method of claim 89 wherein a remote module is a device attached to the object.

91. The method of claim 89 wherein the altered current flow includes two or more changes in the current flow.

92. The method of claim 89 wherein the current flow is a DC current flow and the altered current flow includes at least one change in the magnitude of the DC current flow.

93. The method of claim 89 wherein a remote module includes a transmitter and the central module includes a receiver.

94. The method of claim 89 wherein the current flows through a center- tap of at least one isolation transformer.

95. The method of claim 89 wherein a remote module is integrated into the object.

96. The method of claim 95 wherein the remote module consists of one or more electrical components.

97. The method of claim 89 wherein the central module is integrated into centralized network equipment.

98. The method of claim 97 wherein the centralized network equipment is a hub.

99. The method of claim 97 wherein the centralized network equipment is a patch panel.

100. The method of claim 89 wherein the central module includes at least one power source.

101. The method of claim 89 wherein the information is utilized to selectively provide one or more electrical signals to one or more objects.

102. The method of claim 101 wherein at least one electrical signal is a DC current signal.

103. The method of claim 89 wherein the selected conductors are the same conductors used for normal network communication.

104. The method of claim 89 wherein the number of selected conductors is four.

105. The method of claim 89 wherein the information uniquely distinguishes the object.

106. The method of claim 89 wherein the information identifies an electronic attribute of the object.

107. The method of claim 89 wherein the information identifies a network attribute of the object.

108. The method of claim 89 wherein the information identifies a physical attribute of the object.

109. The method of claim 89 wherein the information identifies a physical configuration within the object.

110. The method of claim 89 wherein the information is utilized to distinguish between different objects.

111. The method of claim 89 wherein the information identifies a software configuration of the object.

112. The method of claim 89 wherein the information identifies the port location of the object.

113. The method of claim 89 wherein the information is utilized by a control circuit.

114. The method of claim 89 wherein the information is utilized to provide a notification signal.

115. The method of claim 89 wherein the central module interrogates the object connected to the network.

116. The method of claim 115 wherein the central module selectively controls network services to the object based upon the interrogation.

117. The method of claim 89 wherein the altered current flow results from at least one change in voltage across the selected conductors.

118. The method of claim 89 wherein the altered current flow results from at least one change in impedance across the selected conductors.

119. The method of claim 89 wherein the selected conductors form a current loop through the object and the flow of current through the current loop indicates a physical connection of the object to the network.

120. The method of claim 89 wherein the information can be conveyed even if the object is powered off.

121. The method according to claims 89-118 or 119 wherein the network includes an Ethernet network and the cables are twisted pair Ethernet cables.

122. The method according to claims **89-118** or **119** wherein the object is a piece of Ethemet equipment and normal network communication is BASE-T Ethernet.

123. The method of claim **121** wherein the information can be conveyed even if the object is powered off.

124. The method of claim **122** wherein the information can be conveyed even if the object is powered off.

125. The system according to claims **16** or **17** wherein the network includes an Ethernet network and the cables are twisted pair Ethemet cables.

126. The system according to claims **16** or **17** wherein a piece of equipment is Ethemet equipment and normal network communication is BASE-T Ethemet.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,457,250 B2
APPLICATION NO. : 10/668708
DATED : November 25, 2008
INVENTOR(S) : John Austermann, III et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Drawings –

Delete drawing Sheet 1 of 13, and substitute therefor attached drawing sheet

Column 6, Line 51:	"central module 16." should be --central module 15.--
Column 14, Line 38:	"Loop" should be --Loop.--
Column 14, Line 41:	"word" should be --word.--
Column 14, Line 45:	"framing" should be --framing.--
Column 14, Line 46:	"complete" should be --complete.--
Column 15, Line 9:	"stream)" should be --stream).--
Column 17, Line 27, Claim 2:	after "Information" insert --communicated to the central module is over the same--

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,457,250 B2
APPLICATION NO. : 10/668708
DATED : November 25, 2008
INVENTOR(S) : John Austermann, III et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 21, Line 18, Claim 79:	"an" should be --the--
Column 22, Line 5, Claim 94:	"center- tap" should be --center-tap--
Column 23, Line 2, Claim 122:	"Ethemet" should be --Ethernet--
Column 24, Line 3, Claim 125:	"Ethemet" should be --Ethernet--
Column 24, Line 5, Claim 126:	"Ethemet" should be --Ethernet--
Column 24, Line 6, Claim 126:	"Ethemet" should be --Ethernet.--

Signed and Sealed this

Twenty-first Day of July, 2009

John Doll

JOHN DOLL
Acting Director of the United States Patent and Trademark Office

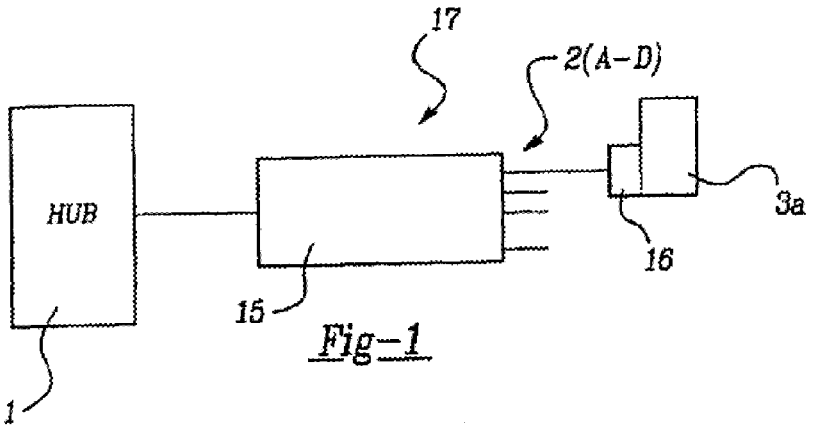


Fig-1

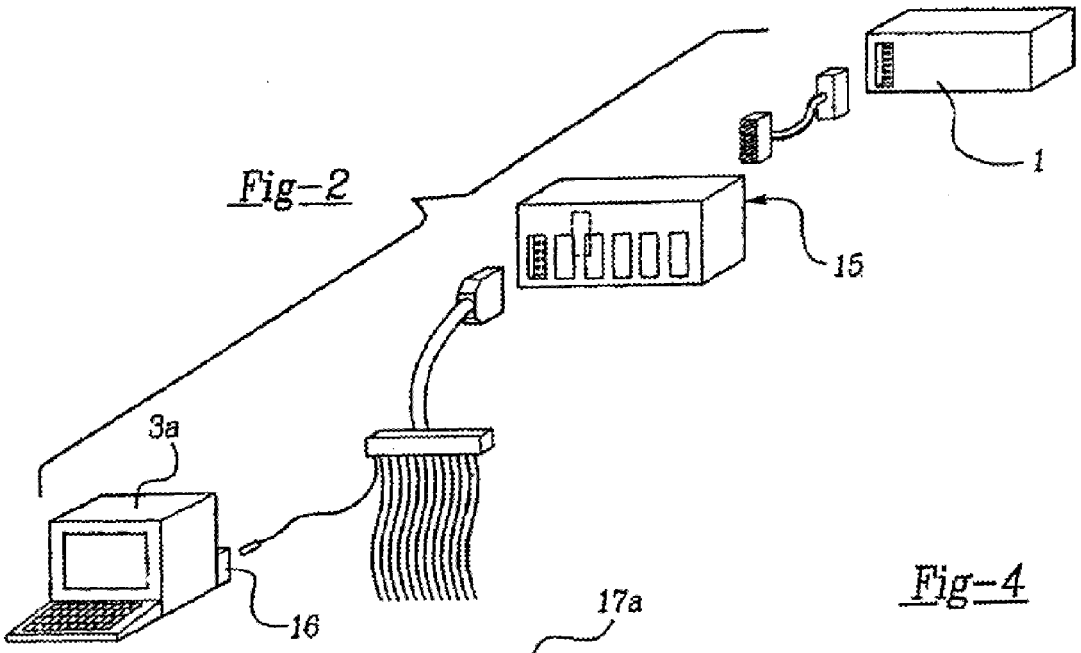


Fig-2

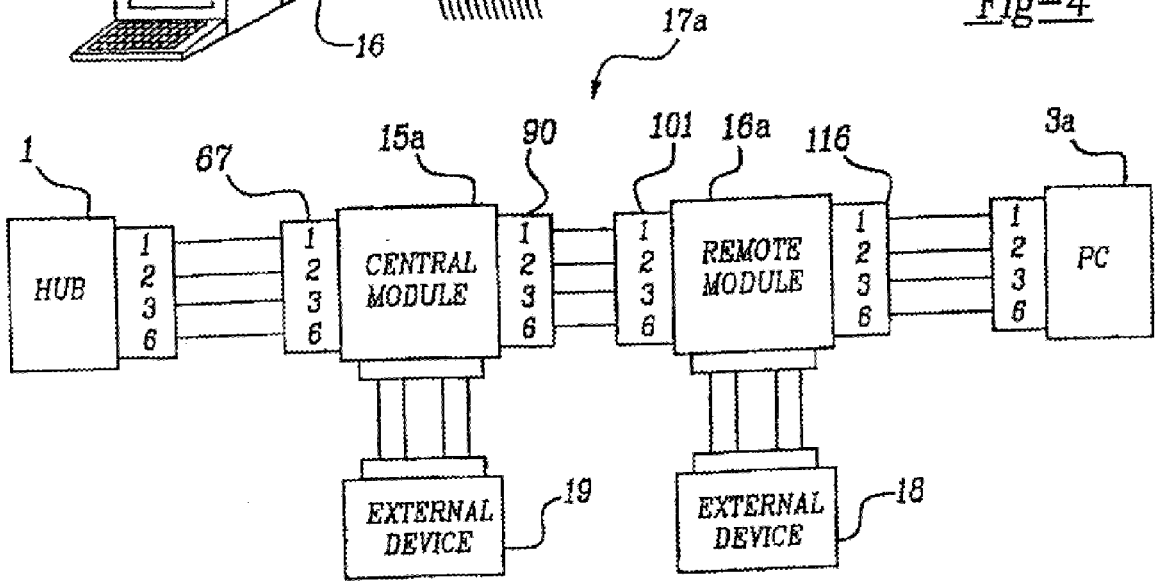


Fig-4

US007457250C1

(12) EX PARTE REEXAMINATION CERTIFICATE (8062nd)

United States Patent
Austermann, III et al.

(10) **Number: US 7,457,250 C1**
(45) **Certificate Issued: Mar. 1, 2011**

(54) **SYSTEM FOR COMMUNICATING WITH ELECTRONIC EQUIPMENT**

(75) Inventors: **John F Austermann, III**, Huntington Woods, MI (US); **Marshall B Cummings**, Troy, MI (US)

(73) Assignee: **Chrimar Systems, Inc.**, Livonia, MI (US)

Reexamination Request:
No. 90/009,513, Sep. 24, 2009

Reexamination Certificate for:
Patent No.: **7,457,250**
Issued: **Nov. 25, 2008**
Appl. No.: **10/668,708**
Filed: **Sep. 23, 2003**

Certificate of Correction issued Jul. 21, 2009.

Related U.S. Application Data

(63) Continuation of application No. 09/370,430, filed on Aug. 9, 1999, now Pat. No. 6,650,622, which is a continuation-in-part of application No. PCT/US99/07846, filed on Apr. 8, 1999.
(60) Provisional application No. 60/081,279, filed on Apr. 10, 1998.

(51) **Int. Cl.**
H04L 12/12 (2006.01)
G08B 13/14 (2006.01)

(52) **U.S. Cl.** **370/241**; 340/568.1; 370/445
(58) **Field of Classification Search** 370/241
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

202,495	A	4/1878	Watson
406,567	A	7/1889	Edison
2,846,509	A	8/1958	Dubuar
3,500,132	A	3/1970	Garrett
3,535,472	A	10/1970	Babbitt, III
3,593,274	A	7/1971	Krugler, Jr.
3,597,549	A	8/1971	Farmer et al.
3,618,065	A	11/1971	Trip et al.
3,634,845	A	1/1972	Colman
3,731,012	A	5/1973	Shaffer

(Continued)

FOREIGN PATENT DOCUMENTS

DE	3907652	A1	9/1990
DE	4203304	A1	8/1992

(Continued)

OTHER PUBLICATIONS

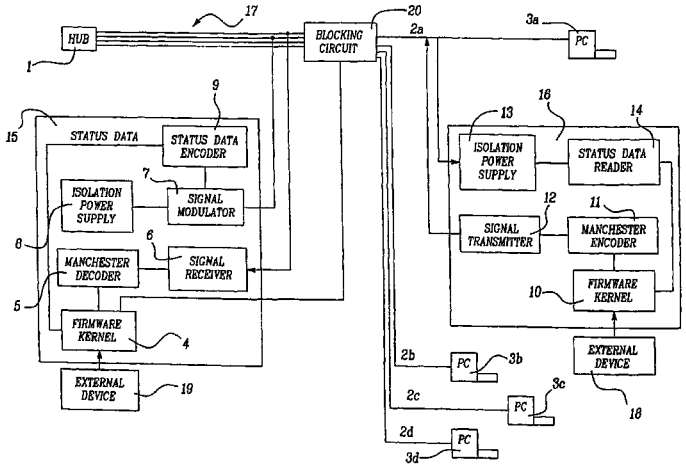
"100 Mb/s data Transmission on UTP and STP Cabling for Demand Priority Networks" (By Hewlett Packard, HP Laboratories Bristol, HPL–94–88, Oct. 1994).

(Continued)

Primary Examiner—Eric B Kiss

(57) **ABSTRACT**

In accordance with the teachings of the present invention, a communication system (**17**) is provided for generating and monitoring data over pre-existing conductors (**2**A-**2**D) between associated pieces of networked computer equipment (**3**A-**3**D). The system includes a communication device (**16**) attached to the electronic equipment that transmits information to a central module (**15**) by impressing a low frequency signal on the pre-existing data lines of the remotely located equipment. A receiver (**6**) in the central module (**15**) monitors the low frequency data on the data lines to determine the transmitted information of the electronic equipment. The communication device may also be powered by a low current power signal from the central module (**15**). The power signal to the communication device may also be fluctuated to provide useful information, such as status information, to the communication device. Relocation of the electronic equipment with attached communication device to another location on the network is detected immediately and may be used to update a database. This invention is particularly adapted to be used with an existing Ethernet communications link or equivalents thereof.



U.S. PATENT DOCUMENTS

3,758,728	A	9/1973	Le Roch et al.
3,768,084	A	10/1973	Haynes
3,781,481	A	12/1973	Shaffer et al.
3,818,179	A	6/1974	Mase
3,828,139	A	8/1974	Chambers, Jr.
3,832,521	A	8/1974	Niendorf
3,848,179	A	11/1974	Kayama
3,868,484	A	2/1975	Bolton et al.
3,886,419	A	5/1975	Omura et al.
3,983,338	A	9/1976	Mathauser
4,064,431	A	12/1977	Cote
4,101,878	A	7/1978	Shimizu et al.
4,128,804	A	12/1978	Russell
4,131,767	A	12/1978	Weinstein
4,160,884	A	7/1979	Bishop
4,161,719	A	7/1979	Parikh et al.
4,179,688	A	12/1979	Romney
4,186,339	A	1/1980	Finger
4,191,971	A	3/1980	Dischert et al.
4,232,199	A	11/1980	Boatwright et al.
4,254,305	A	3/1981	Treiber
4,260,882	A	4/1981	Barnes
4,268,723	A	5/1981	Taylor
4,277,740	A	7/1981	Parks
4,282,407	A	8/1981	Stiefel
4,290,056	A	9/1981	Chow
4,303,073	A	12/1981	Archibald
4,313,081	A	1/1982	Smith
4,315,107	A	2/1982	Ciesielka et al.
4,322,677	A	3/1982	Wright
4,349,703	A	9/1982	Chea, Jr.
4,367,455	A	1/1983	Fried
4,388,667	A	6/1983	Saurenman
4,397,020	A	8/1983	Howson
4,398,066	A	8/1983	Sinberg
4,410,982	A	10/1983	Fleischfresser et al.
4,463,352	A	7/1984	Forbes et al.
4,467,314	A	8/1984	Weikel et al.
4,475,079	A	10/1984	Gale
4,487,836	A	12/1984	Takayanagi et al.
4,494,541	A	1/1985	Archibald
4,507,568	A	3/1985	Ziegler et al.
4,527,216	A	7/1985	Stammely
4,528,667	A	7/1985	Fruhauf
4,532,626	A	7/1985	Flores et al.
4,535,401	A	8/1985	Penn
4,564,726	A	1/1986	Ibata
4,622,541	A	11/1986	Stockdale
4,639,714	A	1/1987	Crowe
4,656,318	A	4/1987	Noyes
4,661,797	A	4/1987	Schmall
4,686,514	A	8/1987	Liptak, Jr. et al.
4,692,761	A	9/1987	Robinton
4,712,233	A	12/1987	Kuo
4,717,896	A	1/1988	Graham
4,723,267	A	2/1988	Jones et al.
4,731,810	A	3/1988	Watkins
4,751,498	A	6/1988	Shalvi et al.
4,755,792	A	7/1988	Pezzolo et al.
4,766,386	A	8/1988	Oliver et al.
4,779,153	A	10/1988	Tsubota
4,782,355	A	11/1988	Sakai et al.
4,785,812	A	11/1988	Pihl et al.
4,799,211	A	1/1989	Felker et al.
4,815,106	A	3/1989	Propp et al.
4,817,106	A	3/1989	Thompson
4,821,319	A	4/1989	Middleton et al.
4,825,349	A	4/1989	Marcel
4,839,886	A	6/1989	Wu et al.
4,875,223	A	10/1989	Curtis
4,884,263	A	11/1989	Suzuki
4,884,287	A	11/1989	Jones et al.
4,885,563	A	12/1989	Johnson et al.
4,901,003	A	2/1990	Clegg
4,901,217	A	2/1990	Wilson
4,903,006	A	2/1990	Boomgaard
4,916,621	A	4/1990	Bean et al.
4,926,158	A	5/1990	Zeigler
4,937,811	A	6/1990	Harris
4,951,309	A	8/1990	Gross et al.
4,969,179	A	11/1990	Kanare et al.
4,973,954	A	11/1990	Schwarz
4,992,774	A	2/1991	McCullough
4,998,850	A	3/1991	Crowell
5,003,457	A	3/1991	Ikei et al.
5,007,858	A	4/1991	Daly et al.
5,020,773	A	6/1991	Tuft et al.
5,021,779	A	6/1991	Bisak
5,029,201	A	7/1991	Bindels
5,032,833	A	7/1991	Laporte
5,033,112	A	7/1991	Bowling et al.
5,038,782	A	8/1991	Gevins et al.
5,056,131	A	10/1991	Kanare et al.
5,059,782	A	10/1991	Fukuyama
5,059,948	A	10/1991	Desmeules
5,063,585	A	11/1991	Shapiro
5,066,939	A	11/1991	Mansfield, Jr.
5,066,942	A	11/1991	Matsuo
5,076,763	A	12/1991	Anastos et al.
5,077,526	A	12/1991	Vokey et al.
5,093,828	A	3/1992	Braun et al.
RE33,900	E	4/1992	Howson
5,119,402	A	6/1992	Ginzburg et al.
5,121,482	A	6/1992	Patton
5,121,500	A	6/1992	Arlington et al.
5,131,033	A	7/1992	Reum
5,168,170	A	12/1992	Hartig
5,179,710	A	1/1993	Coschieri
5,189,409	A	2/1993	Okuno
5,192,231	A	3/1993	Dolin, Jr.
5,199,049	A	3/1993	Wilson
5,200,877	A	4/1993	Betton et al.
5,222,164	A	6/1993	Bass, Sr. et al.
5,223,806	A	6/1993	Curtis et al.
5,235,599	A	8/1993	Nishimura et al.
5,241,160	A	8/1993	Bashan et al.
5,255,962	A	10/1993	Neuhaus et al.
5,264,777	A	11/1993	Smead
5,267,238	A	11/1993	Yano et al.
5,270,896	A	12/1993	McDonald
5,275,172	A	1/1994	Ives
5,280,251	A	1/1994	Strangio
5,285,477	A	2/1994	Leonowich
5,302,889	A	4/1994	Marsh
5,306,956	A	4/1994	Ikeda et al.
5,313,642	A	5/1994	Seigel
5,315,237	A	5/1994	Iwakura et al.
5,321,372	A	6/1994	Smith
5,323,461	A	6/1994	Rosenbaum et al.
5,333,177	A	7/1994	Braitberg et al.
5,345,422	A	9/1994	Redwine
5,345,592	A	9/1994	Woodmas
5,351,272	A	9/1994	Abraham
5,353,009	A	10/1994	Marsh et al.
5,368,041	A	11/1994	Shambroom
5,379,441	A	1/1995	Watanabe et al.
5,381,804	A	1/1995	Shambroom
5,384,429	A	1/1995	Bulson et al.
5,389,882	A	2/1995	I'Anson et al.
5,408,669	A	4/1995	Stewart et al.
5,414,708	A	5/1995	Webber et al.

5,422,519 A	6/1995	Russell
5,438,606 A	8/1995	Cerulli
5,440,335 A	8/1995	Beveridge
5,441,520 A	8/1995	Olsen et al.
5,444,184 A	8/1995	Hassel
5,452,344 A	9/1995	Larson
5,455,467 A	10/1995	Young et al.
5,457,629 A	10/1995	Miller et al.
5,461,671 A	10/1995	Sakuragi et al.
5,467,384 A	11/1995	Skinner, Sr.
5,483,574 A	1/1996	Yuyama
5,483,656 A	1/1996	Oprescu et al.
5,488,306 A	1/1996	Bonaccio
5,491,463 A	2/1996	Sargeant et al.
5,493,684 A	2/1996	Gephardt et al.
5,498,911 A	3/1996	Bossler et al.
5,513,370 A	4/1996	Paul
5,514,859 A	5/1996	Seigel
5,515,303 A	5/1996	Cargin, Jr. et al.
5,517,172 A	5/1996	Chiu
5,519,882 A	5/1996	Asano et al.
5,528,248 A	6/1996	Steiner et al.
5,528,661 A	6/1996	Siu et al.
5,532,898 A	7/1996	Price
5,537,468 A	7/1996	Hartmann
5,540,235 A	7/1996	Wilson
5,541,957 A	7/1996	Lau
5,548,466 A	8/1996	Smith
5,560,022 A	9/1996	Dunstan et al.
5,560,357 A	10/1996	Faupel et al.
5,563,489 A	10/1996	Murry
5,570,002 A	10/1996	Castleman
5,572,182 A	11/1996	De Pinho Filho et al.
5,574,748 A	11/1996	Vander Mey et al.
5,581,772 A	12/1996	Nanno et al.
5,594,332 A	1/1997	Harman et al.
5,596,637 A	1/1997	Pasetti et al.
5,608,545 A	3/1997	Kagawa
5,608,792 A	3/1997	Laidler
5,617,418 A	4/1997	Shirani et al.
5,623,184 A	4/1997	Rector
5,630,058 A	5/1997	Mosley et al.
5,631,570 A	5/1997	King
5,635,896 A	6/1997	Tinsley et al.
5,642,248 A	6/1997	Campolo et al.
5,649,001 A	7/1997	Thomas et al.
5,652,479 A	7/1997	LoCascio et al.
5,652,575 A	7/1997	Pryor et al.
5,652,893 A	7/1997	Ben-Meir et al.
5,652,895 A	7/1997	Poisner
5,655,077 A	8/1997	Jones et al.
5,659,542 A	8/1997	Bell et al.
5,664,002 A	9/1997	Skinner, Sr.
5,670,937 A	9/1997	Right et al.
5,671,354 A	9/1997	Ito et al.
5,675,371 A	10/1997	Barringer
5,675,811 A	10/1997	Broedner et al.
5,675,813 A	10/1997	Holmdahl
5,678,547 A	10/1997	Faupel et al.
5,678,559 A	10/1997	Drakulic
5,679,987 A	10/1997	Ogawa
5,684,826 A	11/1997	Ratner
5,684,950 A	11/1997	Dare et al.
5,686,826 A	11/1997	Kurtz et al.
5,689,230 A	11/1997	Merwin et al.
5,696,660 A	12/1997	Price
5,706,287 A	1/1998	Leimkoetter
5,729,204 A	3/1998	Fackler et al.
5,742,514 A	4/1998	Bonola
5,742,833 A	4/1998	Dea et al.
5,758,101 A	5/1998	Pemberton
5,761,084 A	6/1998	Edwards
5,766,133 A	6/1998	Faisandier
5,779,196 A	7/1998	Timar
5,781,015 A	7/1998	Duffin et al.
5,783,999 A	7/1998	Price et al.
5,784,441 A	7/1998	Davis et al.
5,790,363 A	8/1998	Chaudhry
5,796,185 A	8/1998	Takata et al.
5,796,965 A	8/1998	Choi et al.
5,799,040 A	8/1998	Lau
5,799,196 A	8/1998	Flannery
5,802,042 A	9/1998	Natarajan et al.
5,802,305 A	9/1998	McKaughan et al.
5,805,597 A	9/1998	Edem
5,805,904 A	9/1998	Jung
5,808,846 A	9/1998	Holce et al.
5,810,606 A	9/1998	Ballast et al.
5,814,900 A	9/1998	Esser et al.
5,815,665 A	9/1998	Teper et al.
5,828,293 A	10/1998	Rickard
5,834,942 A	11/1998	De Angelis
5,835,005 A	11/1998	Furukawa et al.
5,836,785 A	11/1998	Lee
5,841,203 A	11/1998	Chambers et al.
5,842,955 A	12/1998	Wilkinson
5,845,150 A	12/1998	Henion
5,845,190 A	12/1998	Bushue et al.
5,848,149 A	12/1998	Chen et al.
5,854,839 A	12/1998	Chen et al.
5,859,584 A	1/1999	Counsell et al.
5,859,596 A	1/1999	McRae
5,884,086 A	3/1999	Amoni et al.
5,915,002 A	6/1999	Shimosako
5,918,016 A	6/1999	Brewer et al.
5,920,253 A	7/1999	Laine
5,923,363 A	7/1999	Elberbaum
5,929,624 A	7/1999	Ricq et al.
5,933,073 A	8/1999	Shuey
5,933,590 A	8/1999	Allen
5,937,033 A	8/1999	Bellows
5,939,801 A	8/1999	Bouffard et al.
5,944,659 A	8/1999	Flach et al.
5,944,824 A	8/1999	He
5,944,831 A	8/1999	Pate et al.
5,946,180 A	8/1999	Simpson
5,949,806 A	9/1999	Ness et al.
5,960,208 A	9/1999	Obata et al.
5,995,348 A	11/1999	McCartan et al.
5,995,353 A	11/1999	Cunningham et al.
6,005,760 A	12/1999	Holce et al.
6,011,680 A	1/2000	Solleder et al.
6,011,794 A	1/2000	Mordowitz et al.
6,011,910 A	1/2000	Chau et al.
6,016,519 A	1/2000	Chida et al.
6,018,452 A	1/2000	Meyerhoefer et al.
6,021,496 A	2/2000	Dutcher et al.
6,031,368 A	2/2000	Klippel et al.
6,033,101 A	3/2000	Reddick et al.
6,038,457 A	3/2000	Barkat
6,047,376 A	4/2000	Hosoe
6,049,139 A	4/2000	Nagaura et al.
6,049,881 A	4/2000	Massman et al.
6,057,670 A	5/2000	Sink et al.
6,092,131 A	7/2000	Caldwell et al.
6,092,196 A	7/2000	Reiche
6,095,867 A	8/2000	Brandt et al.
6,097,761 A	8/2000	Buhring et al.
6,100,471 A	8/2000	Fouache
6,101,459 A	8/2000	Tavallaei et al.
6,121,778 A	9/2000	Moore
6,134,666 A	10/2000	De Nicolo

6,141,763	A		10/2000	Smith et al.
6,144,722	A		11/2000	Anderson et al.
6,175,556	B1		1/2001	Allen, Jr. et al.
6,178,458	B1		1/2001	Wang
6,178,514	B1		1/2001	Wood
6,181,140	B1		1/2001	Vokey et al.
6,219,216	B1		4/2001	Holce et al.
6,233,689	B1		5/2001	Allen et al.
6,236,625	B1		5/2001	Schell et al.
6,243,818	B1		6/2001	Schwan et al.
6,246,748	B1		6/2001	Yano
6,253,121	B1		6/2001	Cline et al.
6,278,357	B1		8/2001	Croushore et al.
6,278,665	B1		8/2001	Schell et al.
6,279,060	B1		8/2001	Luke et al.
6,292,901	B1		9/2001	Lys et al.
6,295,569	B1		9/2001	Shimura et al.
6,301,527	B1		10/2001	Butland et al.
6,317,675	B1		11/2001	Stolzl et al.
6,329,810	B1		12/2001	Reid
6,349,353	B1		2/2002	Lewis et al.
6,351,648	B1		2/2002	Karapetkov et al.
6,366,143	B1		4/2002	Liu et al.
6,366,208	B1		4/2002	Hopkins et al.
6,377,874	B1		4/2002	Ykema
6,393,050	B1		5/2002	Liu
6,393,474	B1		5/2002	Eichert et al.
6,393,607	B1		5/2002	Hughes et al.
6,396,391	B1		5/2002	Binder
6,398,779	B1		6/2002	Buysse et al.
6,418,332	B1		7/2002	Mastrototaro et al.
6,449,348	B1		9/2002	Lamb et al.
6,456,625	B1		9/2002	Itoi
6,459,175	B1		10/2002	Potega
6,473,608	B1	*	10/2002	Lehr et al. 455/402
6,480,510	B1		11/2002	Binder
6,496,103	B1		12/2002	Weiss et al.
6,526,516	B1		2/2003	Ishikawa et al.
6,529,127	B2		3/2003	Townsend et al.
6,535,983	B1		3/2003	McCormack et al.
6,546,494	B1		4/2003	Jackson et al.
6,587,454	B1		7/2003	Lamb
6,681,013	B1		1/2004	Miyamoto
6,701,443	B1		3/2004	Bell
6,744,888	B1		6/2004	El-Kik et al.
6,889,095	B1		5/2005	Eidson et al.

FOREIGN PATENT DOCUMENTS

DE	4138065	A1	5/1993
EP	0357482	A2	3/1990
EP	0386659	A2	9/1990
EP	0584447	A1	3/1994
EP	0639916	A2	2/1995
EP	0852018	A1	7/1998
FR	2682843	A1	4/1993
GB	224991	A	11/1924
JP	60164289	A	8/1985
JP	63018741	A	1/1988
JP	63059144	A	3/1988
JP	6416053		1/1989
JP	01160198	A	6/1989
JP	1160198	A	6/1989
JP	02087762	A	3/1990
JP	420192		1/1992
JP	4180430	A	6/1992
JP	5150854	A	6/1993
JP	06075652	A	3/1994
JP	H6244893		9/1994
JP	H8204782		8/1996
JP	H8307476		11/1996
JP	10013576	A	1/1998
JP	199801357		1/1998
WO	WO-9217968	A1	10/1992
WO	WO-9302510	A1	2/1993
WO	WO 9623377	A1 *	8/1996
WO	WO-9623377	A1	8/1996
WO	W09857248	A2	12/1998
WO	WO-9934591	A1	7/1999

OTHER PUBLICATIONS

"100 Years Of Bell Telephones" {Book} (Author: Richard Mountjoy, A Schiffer Book, 1995).

"ANSI INCITS 229–1994 (R1999)", "for Information Systems—Fibre Distributed Data Interface (FDDI)—Station Management (SMT)" (1994).

"ANSI X3.166–1990"—"for Information Systems"—Fibre Data Distributed Interface (FDDI)—Token Ring Physical Layer Medium Dependent (PMD) (1990).

"ANSI X3.263–1995"—"for Information Technology"—Fibre Distributed Data Interface (FDDI)—Token Ring Twisted Pair Physical Layer Medium Dependent (TP–PMD) (1995).

"ANSI/IEEE 802.4–1990"—"Information Processing systems—Local area networks—Part 4: Token–passing bus access method and physical layer specifications" (1990).

"ANSI/IEEE Std 802.2"—"IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Part 2: Logical Link Control" (1998 Edition).

"ANSI/IEEE Std 802.5–1985—ISO/DP 8802/5"—Local area Networks—ANSI/IEEE Standard ISO Draft Proposal—Token Ring Access Method (1985).

"ANSI/IEEE Std 802.5–1998E"—Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Part 5: Token ring access method and Physical Layer specifications (1998).

Data Cabling—Still In The Melting Pot? (by The Cabling Partnership) (Jul. 21, 1998).

"EIA Interim Standard Omnibus Specification—Local Area Network Twisted Pair Data Communications Cable—NQ–EIA/IS–43" (EIA, Sep. 1987).

"IEEE Std 1802.3–1991"—"Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications"—"Currently Contains Attachment Unit Interface (AUI) Cable (Section 4)" (Aug. 9, 1991).

"IEEE Std 802–1990"—"IEEE Standards for Local and Metropolitan Area Networks: Overview and Architecture" (Nov. 20, 1990).

"IEEE Std. 802.5c–1991"—"Supplement to Token Ring for Dual Access Method and Physical Layer Specifications"—"Recommended Practice for Dual Ring Operation with Wrapback Reconfiguration" (Mar. 21, 1991).

"Implementation And Applications Of DSL Technology" {Book} (Authors: Golden, Dedieu & Jacobsen, Auerbach Publications, 2008).

"Introduction To Telephones And Telephone Systems" {Book} (Author: A. Michael Noll, Second Edition, 1991).

"ISO/IEC 14709–2"—"Information technology—Configuration of Customer Premises Cabling (CPC) for Applications—Part 2: Integrated Services Digital Network (ISDN) primary rate" (First edition 1998–05).

"ISO/IEC 8877"—"Information technology—Telecommunications and information exchange between systems—Interface connector and contact assignments for ISDN Basic Access Interface located at reference points S and T" (Second edition 1992–11–15).

"ISO/IEC 9314–4"—"Information technology—Fibre distributed data interface (FDDI)—Part 4: Single–mode fibre physical layer medium dependent (SMF–PMD)" (First edition 1999–10).

"ITU–T 1.430"—"Integrated Services Digital Network (ISDN)—ISDN User–Network Interfaces"—"Basic User–Network Interface—Layer 1 Specification" (Nov. 1995).

"Medium attachment unit and baseband medium specifications, type 10BASE2" (IEEE 802.3a within IEEE 802.3 2000 Edition).

"Medium Attachment Unit and baseband medium specifications, type 10BASE5" (IEEE 802.3–1985 within IEEE Std 802.3, 2000 Edition).

"Old–Time Telephones! Design, History And Restoration" {Book} (Author: Ralph O Meyer, A Schiffer Book With Price Guide For Collectors, 2005).

"Physical Coding Sublayer (PCS), Physical Medium Attachment (PMA) sublayer and baseband medium, type 100BASE–T4" (within IEEE 802.3u within IEEE Std 802.3, 1998 Edition).

"Physical signaling, medium attachment, and baseband medium specifications, type 1BASE5" (IEEE 802.3e–1987 within IEEE Std 802.3, 2000 Edition).

"Subscriber Loop Signaling And Transmission Handbook—Analog" {Book} (Author: Whitham D. Reeve, IEEE Press, 1992.

"Telephones—Antiques To Modern" {Book} (Author: Kate E. Dooner, A Schiffer Book for Collectors, 1997).

"TIA/EIA–568–A"—"Commercial Building Telecommunications Cabling Standard" (Oct. 6, 1995).

"TIA/EIA–568–A–1"—"Propagation Delay and Delay Skew Specifications for 1000 ohm 4–Pair Cable" (Aug. 20, 1997).

"TIA/EIA–568–A–2"—"Corrections and Additions to TIA/EIA–568–A" (Jul. 28, 1998).

"TIA/EIA–568–A–3"—"Addendum No. 3 to TIA/EIA–568–A" (Dec. 10, 1998).

"TIA/EIA–568–A–4"—"Production Modular Cord NEXT Loss Test Method and Requirements for Unshielded Twisted–Pair Cabling" (Nov. 29, 1999).

"TIA/EIA–568–A–5"—"Transmission Performance Specifications for 4–Pair 100 ohm Category 5e Cabling" (Jan. 27, 2000).

"Universal Service Ordering Codes" (pp. 47–57) {Date Unknown}.

Advanced Micro Devices, "Implementing FDDI Over Copper—The ANSI X3T9.5 Standard —Application Note", Pub. #18258, Rev. A (Nov. 1993).

Advertisement for Watchdog Network Monitor, LAN Magazine,vol. 5, No. 6, 5 pages (Jun. 1990).

AMD, Chipcom, Digital, IBM, Motorola and SynOptics, "Report On Action Item to Merge STP–PMD Proposals", (Aug. 20, 1991).

Anonymous, "Theft Detection Means for Use with Coaxial Cables", 1 page (undated).

AT&T Technologies, "Telecommunications Transmission Engineering", vol. 1, Principles (1975).

Bay Networks Public Information, "LattisNet (Pre–10BaseT Versus 10BaseT", Technical Response Center, Technical Tip (Date Unknown).

Bradley et al, "Track devices on a Mac network", The Local Area Network Magazine 7.n9, p. 162(1) (Sep. 1992).

Bradley et al, "Unix–based Tracking Software", The Local Area Network Magazine 7.n9, p. 162(2) (Sep. 1992).

Chipcom Corporation, "Online FDDI Media Modules Release Notes" (Apr. 14, 1994).

Coilcraft, "10 BASE T Transformers—Dual Transformer Package" (Jun. 1989).

Colin et al, "Testing the LAN testers", Network World, Sep. 10, (1990) (pp. 39–40, 44–45,48, 74).

Communications Week, "Crescendo Preps PC CDDI Card" (Oct. 26, 1992).

Computerworld, "Network Peripherals Cuts FDDI Prices" (Dec. 7, 1992).

Computerworld, "Vendors Back Next–Generation FDDI; Unshielded Twisted–Pair Products For High–Speed Nets Leapfrog Draft Standard" (May 3, 1993).

CSN, "Hub Makers Seek FDDI Link" (Oct. 14, 1991).

DECconcentrator 500 (Technical Description), Jul. 1992.

Digital Equipment Corporation, Intel Corporation and Xerox Corporation, "The Ethernet, A Local Area Network, Data Link Layer and Physical Layer Specifications" (Version 1.0, pp. 53–57, Sep. 30, 1980).

Dixon, Roy C., "Lore Of The Token Ring", IEEE Network Magazine, (Jan. 1987, vol. 1, No. 1, pp. 11–38).

Electronic Design, "FDDI Rides Twisted Pair To The Desktop" (Sep. 16, 1993).

Electronic Engineering Times, "Startups Launch Twisted–Pair Networks" (May 4, 1992).

Electronic Industries Association, "Electrical Characteristics of Balanced Voltage Digital Interface Circuits" EIA Standard, RS–422 (Apr. 1975).

Electronic Industries Association, "Interface Between Data Terminal Equipment And Data Communication Equipment Employing Serial Binary Data Interchange" EIA Standard, EIA–232–C (Aug. 1969).

Electronic Industries Association, "Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems" EIA Standard, EIA–485 (Apr. 1983).

Electronic News, "Firms Agree On Twisted Pair Fast Data" (May 18, 1992).

Fiber Optics News, "Digital Equipment Corp. and Network Peripherals Make FDDI News . . . Working On FDDI Over Copper Specification, Leonard Says" (Jun. 24, 1991).

Gaston, "Intruder Detection", IBM Technical Disclosure Bulletin, vol. 11, No. 12 (May 1969), pp. 1723–1724.

Herivel et al,"Security Alarm System", IBM Corporation, vol. 20, No. 8 (Jan. 1978) pp. 3237–3238.

Hill et al., "16Mb/s Token Ring on Unshielded Twisted Pair Cabling," IEEE (1991), pp. 67–72.

IBM Cabling System, Technical Interface Specification, GA27–3773–1 (2nd Edition, Oct. 1987).

IBM Technical Disclosure Bulletin, "Remote Powering" No. 01–78, pp. 3164–3165—published Jan. 1978.

King, "A Survey of Commercially Available Secure LAN Products", IEEE, (1990) (pp. 239–247).

Kummerie, K.; Reiser, M., "Local–Area Communication Networks—An Overview", Journal Of Telecommunications Networks, Winter 1982, vol. 1, No. 4 (1982).

LAN Technology, "Tut Cuts Thinnest" (Jun. 1992).

LAN Computing, "Network Adapters" (Nov. 1991).
LAN Times, "3Com is Betting On FDDI For LANs; Ships FDDILink NICs" (Jan. 25, 1993).
LAN Times, "Network Peripherals Cuts FDDI Prices By 50 Percent" (Dec. 7, 1992).
LAN Times, "Tutankhamon Raises Level–2 UTP From The Tomb" (Mar. 22, 1993).
LattisNet Model 3305 Ethernet UTP Host Module (Pictures) (8 pages) (date unknown).
LattisNet Model 505 Transceiver Quick Reference Sheet (893–448–A) (2 pages) (date unknown).
LattisNet Model 505 Unshielded Twisted Pair Transceiver (Pictures) (5 pages) (date unknown).
M&T Publishing, "King Tut Expands Ethernet", LAN Technology, (Nov. 1992).
M&T Publishing, "Tutankhamon Electronics Inc., The Assistant Network Manager, Cable Diagnostic Tools, Product Announcement", LAN Technology, (Oct. 15, 1992).
MagicNet Hub (Models: ML 400x & Model 401x) (Pictures) (8 pages) (date unknown).
Mercier et al. "NFS as a User Interface to a High–Performance Data System", 9 pages (Oct. 1991).
Mercier et al.,"Los Alamos National Laboratory's High–Performance Data System", 4 pages (Sep. 1991).
National Semiconductor Corporation, "DP83220 CDL Twisted Pair FDDI Transceiver Device" Advance Information (Oct. 1992).
Newsbytes, "3Com Shows A Bevy Of New Products At InterOp" (May 20, 1992).
Newsbytes, "Tutankhamon Electronics Intros MagicNet LAN" (Nov. 7, 1991).
Original Style Phone (6 Pictures) {Date Unknown}.
PC Week, "4 Vendors' FDDI Managers Pass Interoperability Tests" (Feb. 17, 1992).
PC Week, "ANSI Rejects Plan For Alternate FDDI Media" (Oct. 28, 1991).
PC Week, "Companies Pool Proposals For Copper–Based FDDI Network Standard" (Jun. 29, 1992).
PC Week, "Digital Leads Drive To Twisted–Pair FDDI" (May 27, 1991).
PC Week, "FDDI Vendors Hope To Stir Market With Hubs, Cards" (May 25, 1992).
PC Week, "Group Proposes New FDDI Wiring Scheme: UTP Solution Would Slash Costs" (Aug. 5, 1991).
PC Week, "Microdyne Introduces 100M–bps FDDI board" (Dec. 9, 1991).
PC Week, "Vendor Eyes FDDI Adapter Support For Twisted Pair" (Jun. 10, 1991).
Pulse Engineering Inc., "10BASE T And Ethernet Surface Mount Transformers" (Jun. 1991).
Reddy, "Traffic Control: network monitors keep your LAN from going south.", The Local Area Network Magazine (May 1990), pp. 76(7).
Second Style Phone (3 Pictures) {Date Unknown}.
Shah, Amit; Staddon, Don; Rubin, Izhak; Ratkovic, Aleksandar, "Multimedia Over FDDI", Conference Paper Reprint (Sep. 13, 1992).
SynOptics Communications, Inc., "10BASE–T Host Modules, Transceivers And Network Interface Cards", Internal Product Announcement (Feb. 15, 1990).
SynOptics Communications, Inc., "IBM and SynOptics Business Alliance Update", Sales Note, (Feb. 24, 1992).
SynOptics Communications, Inc., "LattisLink 2800A 10BASE–T Workgroup Concentrator Users Guide" Aug. 1992).
SynOptics Communications, Inc., "LattisNet Basic Network Management Version 3.1", Internal Product Announcement (Jan. 21, 1991).
SynOptics Communications, Inc., "System 3000 FDDI Module—Functional Specification" (Apr. 19, 1991).
SynOptics Communications, Inc., "Systems 2000 10BASE–T Concentrators", Product Announcement, (Sep. 14, 1990).
SynOptics Communications, Inc., "TP–PMD Adaptation For STP Cable Plants" (Apr. 26, 1994).
SynOptics LattisNet System 3000 Ethernet Connectivity Guide (p. 4–2) (Sep. 1991).
SynOptics Series 3000 Hub Management Module Guide, Feb. 1998.
T.H.E. Journal, "School Buildings Linked Via Existing Phone Wire" (May 1992).
TCL Incorporated, "Ethernet/IEEE 802.3 Installation Tester—The TCL Installation Tester Model 2011" (1986).
TCL Incorporated, "The Connection To Ethernet—Transceiver Or MAU Models 2010EB, 2010EBS, 2010I & 2010IS" (1987).
TCL Incorporated, "The Connection To Ethernet/IEEE 802.3 Local Area Networks—Transceiver Or Mau Model 2010DM" (1988).
TCL Incorporated, "The Multiconnection To Ethernet/IEEE 802.3—The TCL Multiport Transceiver Model 2110" (1987).
TCL Incorporated, "The Multiconnection To Ethernet Versions 1 & 2, and IEEE 802.3—The Dual–Mode Multiport Transceiver Model 2110–DM" (1988).
Telecommunications Industry Association, "Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems" TIA Standard, TIA–485–A (Mar. 1998).
The Ethernet, A Local Area Network, Data Link Layer and Physical Layer Specifications, Version 1.0, Sep. 30, 1980.
The Ethernet, A Local Area Network, Data Link Layer and Physical Layer Specifications, Version 2.0, Nov. 1982.
The Institute of Electrical and Electronics Engineers, "IEEE Standard Digital Interface for Programmable Instrumentation", ANSI/IEEE Std 488–1978; Revision of ANSI/IEEE Std 488–1975—Includes supplement IEEE Std 488A–1980 (Jun. 9, 1978).
Third Style Phone (1 Picture) {Date Unknown}.
Universal Serial Bus Specification, Revision 1.1, Sep. 23, 1998 (327 pages).
Valor, "Ethernet/Cheapernet Lan Coupling Transformers" (Oct. 1989).
Van–Mierop, "Extending Ethernet/802.3 Over FDDI Using the FX 8000", High Speed Local Area Networks, II, Elsevier Science Publishers B. V. (North–Holland), IFIP (1990), pp. 259–267.
Yount, "Security Monitor for Office Equipment", IBM Technical Disclosure Bulletin, vol. 24, No. 1B (Jun. 1981) pp. 576–577.
ZD Net, "Bucking the Trend: A Low–Cost Ethernet LAN", Computer Shopper, (Oct. 1991).
Entertainment Services and Technology Association (ESTA)—Recommended Practice for Ethernet Cabling Systems in Entertainment Lighting Applications [44 pages] (1996).

Model 505 Unshielded Twisted Pair Transceiver Schematic by SynOptics Communications, Inc. [5 pages] (Jan. 17, 1990).
Model 505 Chip Transceiver Schematic [3 pages] (Jun. 27, 1988).
LattisNet Product Overview [27 pages] (Apr. 1990).
Network World Article: "SynOptics touts FDDI products affordability" [2 pages] (Sep. 2, 1991).
Communication Week Article: "FDDI Spec Consortium" [2 pages] (May 27, 1991).
Network World Article: "Spec details use of FDDI over shielded twisted pair" [3 pages] (May 27, 1991).
Network World Article: "DEC to show new FDDI, E–mail wares" [2 pages] (Jan. 28, 1991).
Network World Article: "Proposed groups eye alternate FDDI media" [3 pages] (Nov. 12, 1990).
H4000 Ethernet Transceiver Technical Manual [67 pages] (1982).
Worldwide History of Telecommunications by Anton A. Huurdeman [38 pages] , no date.
IBM Token–Ring Network Technology, # GA27–3832–0 [146 pages] (1986).
IBM—Technical Reference—Personal Computer Hardware Reference Library, # 69X7862 [476 pages] (Jun. 1986).
Token–Ring Network—Architecture Reference, # SC30–3374–02 [485 pages] (Sep. 1989).
Using the IBM Cabling System with Communication Products, # GA27–3620–1 [355 pages] (Apr. 1986).
Network World Article: "Token–ring sales take off" [3 pages] (Aug. 17, 1987).
Closeup Article—The LAN Inner Circle [15 pages] (Mar. 25, 1985).
Perspective Computer Systems News Article—Making Sure The Pieces Fit [7 pages] (Mar. 1988).
Data Communications—McGraw–Hill's Technology Magazine For Network Managers: "Multivendor token ring networks coming of age" [5 pages] (Nov. 21, 1989).
Understanding Token Ring Protocols And Standards by James T. Carlo, Robert D. Love, Michael S. Siegel and Kenneth T. Wilson—Artech House [4 pages] (1998).
IBM Token–Ring Network Operates on Telephone Twisted–Pair Media (Marketing Announcement) by IBM [4 pages] (Oct. 15, 1985).
Design Of A Twisted Pair Cable For A Token Passing Local Area Network (Intl. Wire & Cable Symposium Proceedings) By Paul Abramson—IBM Corporation [3 pages] (1983).
IBM Cabling System Planning and Installation Guide, # GA27—3361–07 [344 pages] (Oct. 1987).
Local Area Network Station Connector (IBM Technical Disclosure Bulletin, vol. 27 No. 2) by E.J. Annunziata and T.E. Stammely [5 pages] (Jul. 1984).
Product And Price Schedule (SynOptics, Inc.—p. 18 of 25) [1 page] (Aug. 1, 1991).
Technical Report—"The Effect of Ethernet Behavior on Networks using High–performance Workstations and Servers" By Rich Seifert (Networks and Commnications Consulting) [25 pages] (Mar. 3, 1995).
Technical Report—"Issues in LAN Switching and Migration from a Shared LAN Environment" By Rich Seifert (Networks and Communications Consulting) [28 pages] (Nov. 1995).
IBM Token–Ring Network—Introduction and Planning Guide, # GA27–3677–03 [241 pages] (Sep. 1990).
IBM—"8209 LAN Bridge—Attachment Module Guide for the IBM Token–Ring Network", # GA27–3915–01 [187 pages] (Apr. 1992).
IBM—"International Technical Support Organization High–Speed Networking Technology: An Introductory Survey", #GC24–3816–02 [480 pages] (Jun. 1995).
IBM—"Local Area Network Concepts and Products: LAN Architecture", # SG24–4753–00 [262 pages] (May 1996).
IBM—"Local Area Network Concepts and Products: Adapters, Hubs and ATM", # SG24–4754–00 [326 pages] (May 1996).
"The IBM Token–Ring Network—A functional Overview" by Norman C. Strole, IEEE Network Magazine, vol. 1, No. 1 [8 pages] (1987).
FDDI Metallic Media—Unshielded Twisted Pair Physical Layer Medium Dependent (UTP–PMD), Draft Proposed American National Standard, X3T9.5/88–155 [34 pages] (Jun. 17, 1991).
"Developing Ethernet Capability on Unshielded Twisted Pair", by Dr. Ronald V. Schmidt—Telecommunications (28 pages) (Jan. 1988).
"SynOptics Introduces The Industry's Most Powerful And Complete FDDI Solution" by SynOptics [40 pages] Jul. 30, 1991.
Pages from FDDI Articles: 1) "SynOptics touts FDDI products' affordability" by Network World, page No. 4, Sep. 9, 1991, 2) "The copper connection to FDDI" by Network World, page No. 36, Dec. 16, 1991, 3) "Coalition forming to advance FDDI on UTP" by Network World, page No. 1, Jul. 15, 1991, 4) Proposed groups eye alternate FDDI media by Network World, page No. 121, Nov. 12, 1990, 5) "SynOptics supports FDDI over shield twisted pair" by Network World, page No. 23, Jun. 18, 1990, 6) "SynOptics touts FDDI product's affordability" by Network World, page No. 4, Sep. 9, 1991, 7) "SynOptics supports FDDI over shielded twisted pair" by Network World, page No. 23, Jun. 18, 1990, 8) "Spec details use of FDDI over shielded twisted–pair" by Network World, page No. 2, May 27, 1991, 9) "IBM support bolsters FDDI cabling spec" by Network World, page No. 9, Sep. 16, 1991, 10) 37 Start–up offers FDDI adapters for shielded
twisted–pair local nets by Network World, page No. 6, Jun. 10, 1991, 11) "SynOptics to unveil FDDI components" by Network World, page No. 1, Aug. 19, 1991, 12) "Firms integrate efforts" by Network World, page No. 56, May 27, 1991, 13) "FDDI on unshielded wire to be topic as ANSI meet Group to hear presentations backing technology" by Network World, page No. 4, Jun. 17, 1991, 14) "DEC to show new FDDI, E–mail wares" by Network World, page No. 1, Jan. 28, 1991.
"SynOptics supports FDDI over shielded twisted pair" by Local Networking [2 pages] (Jun. 18, 1990).
"SynOptics Distributes LAN Management" by LAN Magazine [4 pages] (May 1991).
"Model 3307 50–Pin 10BASE–T Host Module" by SynOptics Communications, Inc [5 pages] (Nov. 9, 1990).
"Token Ring Tutorial" by SynOptics Communications, Inc [25 pages] (Jan. 1990).
"SynOptics Readies Twisted Pair FDDI Technology For Presentation At ANSI Meeting This Month" by SynOptics Communications, Inc. [2 pages] (Jun. 11, 1990).
"SynOptics Signs Technology Agreements To Speed The Development Of Twisted Pair FDI Products" by SynOptics Communications, Inc. [2 pages] (Sep. 24, 1990).

"Twisted–Pair Ethernet For Everyone" by Denis W. Haskin—Digital Review [3 pages] (Jul. 25, 1988).
"The Importance Of FDDI Interoperability" by SynOptics Communications, Inc. [2 pages] (Aug. 14, 1990).
"What is FDDI's Station Management (SMT)?" by SynOptics Commnications, Inc. [pages] (Oct. 16, 1990).
"IBM and SynOptics Develop New Technology to Support 16/4 Mbs Token Ring Over Unshielded Twisted Pair Wiring" by SynOptics Communications, Inc. [5 pages] (Feb. 24, 1992).
"Shielded Twisted Pair Token Ring Modules, Patch Cables And System 3000 Ethernet/Token Ring Concentrators" by SynOptics Communications, Inc. [10 pages] (Mar. 19, 1990).
Network World Article: "SynOptics supports FDDI over shielded twisted pair" [1 page] (6–18–9?).
"Twisted Pair FDDI Update—The Inside Story About Twisted Pair FDDI Technology" by SynOptics Communications, Inc. [9 pages] (Jun. 29, 1990).
"Phase II LattisNet Token Ring Products Include High Performance Support For Unshielded Twisted Pair Wire At 4 Mb/s & 16 Mb/s, Up To 144 Stations On A Single Ring" by SynOptics Communications, Inc. [53 pages] (Aug. 27, 1990).
"Model 508A 10BASE–T Transceiver" by SynOptics Communications, Inc. [5 pages] (Jan. 14, 1991).
"Model 518 10BASE–T Transceiver For Apple" by SynOptics Communications, Inc. [6 pages] (Jan. 16, 1991).
"SynOptics' System 2000 Featuring The Model 2810" by SynOptics Communications, Inc. [12 pages] (Feb. 12, 1991).
"LattisNet Model 3000–04–R Concentrator With Redundant Power Supplies" by SynOptics Communications, Inc. [9 pages] (Mar. 4, 1991).
"Model 2810–04 Features "Local Load" Capability & Advance LNMS Agent" by SynOptics Communications, Inc. [4 pages] (Aug. 15, 1991).
"Lattisboot Server V1.0 For DOS" by SynOptics Communications, Inc. [5 pages] (Sep. 1, 1991).
"LattisNet Model 955 & Model 956 Token Ring Integrated Media Filters For Unshielded Twisted Pair Lobe Connections" by SynOptics Communications, Inc. [4 pages] (Nov. 4, 1991).
"Model 2800 10BASE–T Workgroup Concentrator—New Version Of The Model 2800 10BASE–T Workgroup Concentrator Offers Greater Value" by SynOptics Communications, Inc. [2 pages] (Oct. 24, 1991).
"Model 3505A Unshielded Twisted Pair Host Module" by SynOptics Communications, Inc. [6 pages] (Nov. 11, 1991).
"LattisNet Ethernet Bridge Manager" by SynOptics Communications, Inc. [9 pages] (Dec. 6, 1991).
"Model 3301–75/3301–93 Ethernet Host Modules" by SynOptics Communications, Inc. [7 pages] (Dec. 30, 1991).
"LattisSecure and the Model 3368 10BASE–T Host Module" by SynOptics Communications, Inc. [12 pages] (Mar. 2, 1992).
"Designing Highly Available FDDI Backbone Networks" by SynOptics Communications, Inc. [12 pages] (Mar. 25, 1992).
"Lattis Talk Model 3394 Router/Repeater" by SynOptics Communications, Inc. [14 pages] (Apr. 20, 1992).
"Model 3513 Token Ring Network Management Module" by SynOptics Communications, Inc. [5 pages] (May 5, 1992).
"2700 Series Token Ring Workgroup Hubs" by SynOptics Communications, Inc. [9 pages] (May 5, 1992).
"Lattis Views Network Management Solutions" by SynOptics Communications, Inc. [10 pages] (Apr. 27, 1992).
"LattisSwitch System 3000" by SynOptics Communications, Inc. [23 pages] (Jun. 8, 1992).
"Ethernet Switching Engine (ESE)" by SynOptics Communications, Inc. [11 pages] (Jun. 8, 1992).
"Lattis EZ–View Version 1.1" by SynOptics Communications, Inc. [3 pages] (Aug. 28, 1992).
"LattisNet Manager for DOS 4.2" by SynOptics Communications, Inc. [4 pages] (Aug. 28, 1992).
"Token Ring Network Management Agent 4.1" by SynOptics Communications, Inc. [2 pages] (Aug. 28, 1992).
"LattisHub 10BASE–T Workgroup Hubs" by SynOptics Communications, Inc. [13 pages] (Oct. 5, 1992).
"Model 550B UTP Token Ring Lobe Media Filter" by SynOptics Communications, Inc. [2 pages] (Oct. 19, 1992).
"Model 3313A & Model 3314A Ethernet Network Management Modules" by SynOptics Communications, Inc. [15 pages] (Oct. 19, 1992).
"Model 3502B Token Ring Host Module" by SynOptics Communications, Inc. [4 pages] (Nov. 9, 1992).
"Model 2722 Local Token Ring Bridge" by SynOptics Communications, Inc. [10 pages] (Nov. 9, 1992.
"Model 27×2 Token Ring Workgroup Concentrators" by SynOptics Communications, Inc. [11 pages] (Nov. 9, 1992).
"Model 3307HD 10BASE–T Host Module" by SynOptics Communications, Inc, [5 pages] (Dec. 11, 1992.
"LattisEZ–View Version 2.0" by SynOptics Communications, Inc. [6 pages] (Nov. 9, 1992).
"LattisNet Basic Network Management For Ethernet And Token Ring" by SynOptics Communications, Inc. [30 pages] (Mar. 4, 1991).
System 3000 Network Configurations by SynOptics Communications, Inc. [14 pages] (Date: Unknown).
"The Model 2810 and SynOptics' Value Added" by SynOptics Communications, Inc. [12 pages] (Dec. 29, 1990).
"Low–Cost 10BASE–T Connectivity Products" by SynOptics Communications, Inc. [6 pages] (May 23, 1990).
"Internetworking Product Directions Announcement" by SynOptics Communications, Inc. [16 pages] (Mar. 4, 1991).
"LattisNet Model 3323S And 3324–ST High–Speed Local Ethernet Bridges" by SynOptics Communications, Inc. [11 pages] (Mar. 4, 1991).
"LattisNet Model 3386 Remote Ethernet Router" by SynOptics Communications, Inc. [16 pages] (Mar. 4, 1991).
"SynOptics introduces industry's most powerful FDDI solution" by Chipcom [3 pages] (Sep. 9, 1991).
The LOCALNetter Newsletter: "Special Report—SynOptics Networking Products", vol. 9, No. 10 [6 pages] (Oct. 1989).
LattisNet Product Overview—A Comprehensive Description of the LattisNet Product Family [39 pages] (Date: Unknown).
"Lattis EZ–View" by SynOptics Communications, Inc. [19 pages] (Date: Unknown).
"LattisNet Model 822 10BASE–T–To–Type 1 Adapter Reference Sheet" by SynOptics Communications, Inc., # 893–029 [6 pages] (Date: Unknown).
"FDDI—Shielded Twisted Pair and Data Grade Unshielded Twisted Pair Physical Layer Medium Dependent (STP/DTP–PMD)", Draft Proposal, Rev 00 [36 pages] (Aug. 15, 1991).

"FDDI Networking on Twisted Pair", Version 0.2 (Author Unknown) [16 pages] (Date: Unknown).
"Shielded Twisted pair Proposal For The TP–PMD Working Group", Proposed by: 1)Advanced Micro Devices, Inc., Sunnyvale, CA, 2) Chipcom Corporation, Southborough, MA, 3) Digital Equipment Corporation, Littleton, MA, 4) Motorola, Inc., Austin, TX, 5) SynOptics Communications, Inc., Santa Clara, CA [15 pages] (Jun. 1991).
"Network World—The Newsweekly of User Networking Strategies", vol. 7, No. 46 [78 pages] (Nov. 12, 1990).
Local Networking Article: "Interoperability top priority for vendors" by Susan Breidenback [2 pages] (Jun. 18, 1990).
Network World Article: "Coalition forming to advance FDDI on UTP" [2 pages] (Jul. 15, 1991).
Network World Article: "SynOptics to unveil FDDI components" [2 pages] (Aug. 19, 1991).
Network World Article: "Start–up offers FDDI adapters for shielded twisted–pair local nets" [8 pages] (Jun. 10, 1991).
Picture (Drawing) of FDDI/Twisted Pair Adaptor Card (Author Unknown) (Date: Unknown).
"FDDI Workgroup Hub Project Proposal" by SynOptics [26 pages] (Jan. 21, 1991).
Communications Week Article: "A Twisted Future" [1 page] (Jun. 18, 1990).
Computer World Article: "Don't yank those wires out just yet" [1 page] (Jun. 18, 1990).
Info World Article: "100–MBPS FDDI Will Run in Twisted–Pair Wiring" by Margie Wylie and Barbara Darrow [1 page] (Jun. 18, 1990).
"Companies Cooperate To Publish Open Specification For FDDI On Shielded Twisted Pair Cable"—"Five Industry Leaders Demonstrate Interoperability of Products" (Author Unknown) [2 pages] (May 21, 1991).
"The Use of Scramblers with Anti Locking Circuit" by Michael P. Spratt, Hewlett Packard [16 pages] (Dec. 6, 1991).
"Wire Fault Detect Function" by AMD, Chipcom, DEC, IBM, Motorola, and SynOptics [2 pages] (Oct. 15, 1991).
UDF: "Line Codes For FDDI Over Copper" by John Cook, BT Laboratories Copper Access Systems Section [10 pages] (Date: Unknown).
"Evaluating PR–4 as a FDDI/UTP PMD Coding Scheme" by Mario Mazzola, Crescendo Communications, Inc. [11 pages] (Feb. 19, 1991).
"FDDI on STP" by Hank Foglia, IBM Communication Systems [19 pages] (Feb. 19, 1991).
"Update on ASC X3T9.5 FDDI" by Jerry Hutchison, Digital Equipment [8 pages] (Jul. 11, 1988).
Glossary—FDDI Fiber Module, Version b1.0a (Author & Reference Unknown) [7 pages] (May 1992).
"MAC–Less FDDI Concentrator command Summary" my Tim Mancour [6 pages] (Mar. 10, 1992).
"FDDI STP–PMD Proposal" (Author Unknown) [35 pages] (Date: Unknown).
"A Low Cost Integratable Solution for FDDI Signaling Over Twisted Pair" by National Semiconductor and Cabletron Systems [20 pages] (Jun. 1991–?).
"FFOL"—"The FDDI Follow–On LAN" (Author Unknown) [5 pages] (Jul. 3, 1991).
"FDDI—A 100 Megabit per Second Local area Network" by Floyd E. Ross, Timeplex—Systems Engineering [8 pages] (Jul. 3, 1991).
"SynOptics FDDI Solutions" by SynOptics [26 pages] (Date: Unknown).
"FDDI—UTP—Investigation" by Synoptics [6 pages] (Date: Unknown).
"A proposal for a Low Cost FDDI UTP/STP PMD Standard" by Mario Mazzola, Crescendo Communications [31 pages] (Oct. 15, 1991).
"STP Proposal—Introduction" by AMD, Chipcom, DEC, IBM, Motorola, SynOptics [60 pages] (Oct. 15, 1991).
"A token–ring network for local data communications" by IBM Systems Journal, vol. 22. [16 pages] (1993).
"The SUPERNET® Family for FDDI—Technical Manual" by Advanced Micro Devices, [112 pages] (Jul. 1989).
"The SUPERNET® Family for FDDI—1991/1992 World Network Data Book" by Advanced Micro Devices, [114 pages].
"Minutes—the Aug. 20, 1991 TP–PMD Meeting. Boulder, Colorado" by Author Unknown [2 pages] (Aug. 20, 1991).
"Alternate Copper Media for FDDI" by Chipcom Corporation, [33 pages] (Jun. 1990).
"FDDI—TPDDI White Paper" by Jamie Warter from Chipcom Corporation, [5 pages] (Sep. 19, 1991).
"Jan. 1992—FDDI Product Direction" by Chipcom Corporation, [12 pages] (Jan. 1992).
"FDDI—An Introduction to Fiber Distributed Data Interface" by Chipcom Corporation, [60 pages] (Date Unknown).
"Project Proposal" by Chipcom Corporation, [146 pages] (Oct. 17, 1989).
"Chipcom LAN Concentrator Spans Multiple Protocols, Cabling Schemes" by Info World, [1 page] (Jan. 29, 1990).
"Chipcom Unveils Twisted Pair/FDDI Technology" by Chipcom Coproration, [4 pages] (Jun. 14, 1990.
"Chipcom's wire hub boasts for range of LANs" by Network World, [1 page] (Feb. 5, 1990).
"Cisco System backs proposed specification for FDDI over shielded twisted–pair" by Business Wire (May 22, 1991) and "News & Analysis FDDI Over STP? Sounds Great, But Where Is It?" by Laura Didio from Lan Times (Jun. 3, 1991) [1 page].
"Minutes of the 20 & 21 Jun. 1990 Meeting" by ASC Task Group X3T9.5, [3 pages] (Jun. 20/21, 1990).
"FDDI—Shielded Twisted Pair and Data Grade Unshielded Twisted Pair Physical Layer Medium Dependent (STP/DTP–PMD)" by Cabletron Systems, FWS Engineering, and National Semiconductor [36 pages] (Dec. 6, 1991).
"SynOptics Distributes LAN Management" & 10BaseT Takes Off by LAN Magazine vol. 5, No. 5, [11 pages] (May 1991).
"Reference Data for Engineers: Radio, Electronics, Computer, and Communications" by Howard W. Sams & Company, [17 pages] (1989).
"Transmission—The IBM token ring will handle up to 72 stations at the full 4–Mbit/s data rate" by Data Communications, [6 pages] (Mar. 1986).
"Token–Ring Local Area Networks: A Perspective" by International Business Machines Corporation, [9 pages] (1982).
"Tut Systems Brings ATM To Desktops with Revolutionary Fast Copper Technology Converter and PMD Transceiver" by Tut Systems [3 pages] (Jul. 11, 1995).
"UB Networks and Tut Systems Bring the First Implementation of ATM To Desktop At 155 Mbps Over UTP/3" by Tut Systems [3 pages] (Jan. 23, 1995).
"Tut Systems Announces Partnership With E/O Networks That Will Marry High–Speed Copper To Fiber Telephony Infrastructure" by Tut Systems [3 pages] (Dec. 12, 1994).

"Tut Systems Appoints New President To Expand Opportunities For Company's Technology" by Tut Systems [3 pages] (Nov. 22, 1994).
"Tut Systems Announces Parallel Port Ethernet Connector That Makes Networking A Snap For Mobile And Desktop Users" by Tut Systems [2 pages] (Nov. 2, 1994).
"Tut Systems Introduces Industry–Standard PCMCIA Ethernet Card For Portables" by Tut Systems [2 pages] (Nov. 2, 1994).
"Tut Systems Announces LocalTalk–to–Ethernet Printer Solution For Silver Streak Product Family" by Tut Systems [2 pages] (Nov. 2, 1994).
"Tut Systems Cuts The Cost Of High–Speed Networking For Education Community" by Tut Systems [2 pages] (May 24, 1994).
"Tut Systems Receives BYTE Magazine's Award Of Distinction" by Tut Systems [2 pages] (Jan. 3, 1994).
"Company Backgrounder" by Tut Systems [6 pages] (Date: Unknown).
The Network Report article: "The Ethernet evolution" by Matthew Taylor [3 pages] (Jan. 1992).
Network World article: "UB, Tut, ODS prep high–speed LAN gear" by Jodi Cohen [1 page] (Jan. 23, 1995).
PCWEEK article: "ComNet focuses on routing, ATM" by Paula Musich and Viki Bernard [1 page] (Jan. 23, 1995).
MacWEEK article: "UB signs up Tut for ATM on copper" by Stephen Howard [1 page] (Jan. 30, 1995).
MacWeek article: "Cheap transceivers vault Tut into ATM, rural I–way markets" by Stephen Howard [1 page] (Dec. 12, 1994).
Interactive Age article: "Broadband to homes" by Richard Karpinski [1 page] (Dec. 12, 1994).
LAN Times article: "Tut Claims 155Mbps On cat 3 Cable" by Erica Roberts [1 page] (Jan. 9, 1995).
Electronic News article: "Data Net" (Author Unknown) [1 page] (Jan. 23, 1993).
Electronic News article: "Tut Transceivers Target Telcos, ATM" by Reinhardt Krause [1 page] (Date: Unknown).
ComputerWorld article: "ATM to run over copper wire" (Author Unknown) [1 page] (Jan. 23, 1995).
Electronic Engineering Times article: "ATM takes to twisted–pair" by Loring Wirbel [1 page] (Dec. 19, 1994).
Communications Week article: "Fast ATM Comes to Copper" by Erica Roberts [2 pages] (Jan. 23, 1995).
Communications Week article: "Cards to Handle Fast ATM on Standard Wire" by Denise Pappalardo [1 page] (Nov. 14, 1994).
Communications Week article: "Prepare Ye The Way: Install Cable Now For Data Transmission Of Tomorrow" (Author Unknown) [1 page] (Date: Unknown).
BYTE article: "Daisy–Chain Ethernet" by Stan Miastkowski [2 pages] (Jan. 1995).
Business Communications Review article: "$500 Per Seat ATM?" (Author Unknown) [1 page] (Jan. 1995).
America's Network article: "You Haven't Heard The Last Of 'Dirty, Noisy' Copper" by Patty Wetli [2 pages] (Jan. 15, 1995).
Information Week article: "ATM: Ready for Lift–Off" by Caryn Gillooly with Mary Panettieri and Joseph Panettieri [1 page] (Feb. 6, 1995).
Electronic Engineering Times article: "E/O Networks aims to bring fiber to the farm" by Loring Wirbel [1 page] (Mar. 6, 1995).
Tut Systems "Technical Overview" (Author Unknown) [3 pages] (Date Unknown).
"Bear Sterns—New Age Media II" by Cliff Friedman [4 pages] (Date Unknown).
"Tutankhamon Electronics, Inc. Presents MagicNet" by Tutankhamon Electronics, Inc. [10 pages] (Date Unknown).
"MagicNet Installation Guide" by Tutankhamon Electronics, Inc. [9 pages] (Jan. 1, 1991).
"The TCL Repeater Model 2210" by Ethernet/IEEE 802.3 Segment to Segment Connection [8 pages] (Date Unknown).
"LattisSwitch System 3000 Network Management", SynOptics Communications, Inc., Product Update [3 pages] (Oct. 16, 1992).
"LattisNet Manager for UNIX 2.0", SynOptics Communications, Inc., Product Announcement [18 pages] (Sep. 23, 1991).
IBM Technical Disclosure Bulletin, No. 01–78, pp. 3164–3165—published Jan. 1978.

* cited by examiner

EX PARTE REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 307

NO AMENDMENTS HAVE BEEN MADE TO THE PATENT

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

The patentability of claims **1**, **2**, **5**, **13**, **15**, **20-32**, **34**, **36**, **41-43**, **45-47**, **49**, **50**, **53**, **54**, **56-68**, **70**, **72**, **77-79**, **81-83**, **85**, **86**, **89**, **90**, **92-104**, **106**, **108**, **113-115**, **117-119**, **121**, and **122** is confirmed.

Claims **3**, **4**, **6-12**, **14**, **16-19**, **33**, **35**, **37-40**, **44**, **48**, **51**, **52**, **55**, **69**, **71**, **73-76**, **80**, **84**, **87**, **88**, **91**, **105**, **107**, **109-112**, **116**, **120**, and **123-126** were not reexamined.

* * * * *